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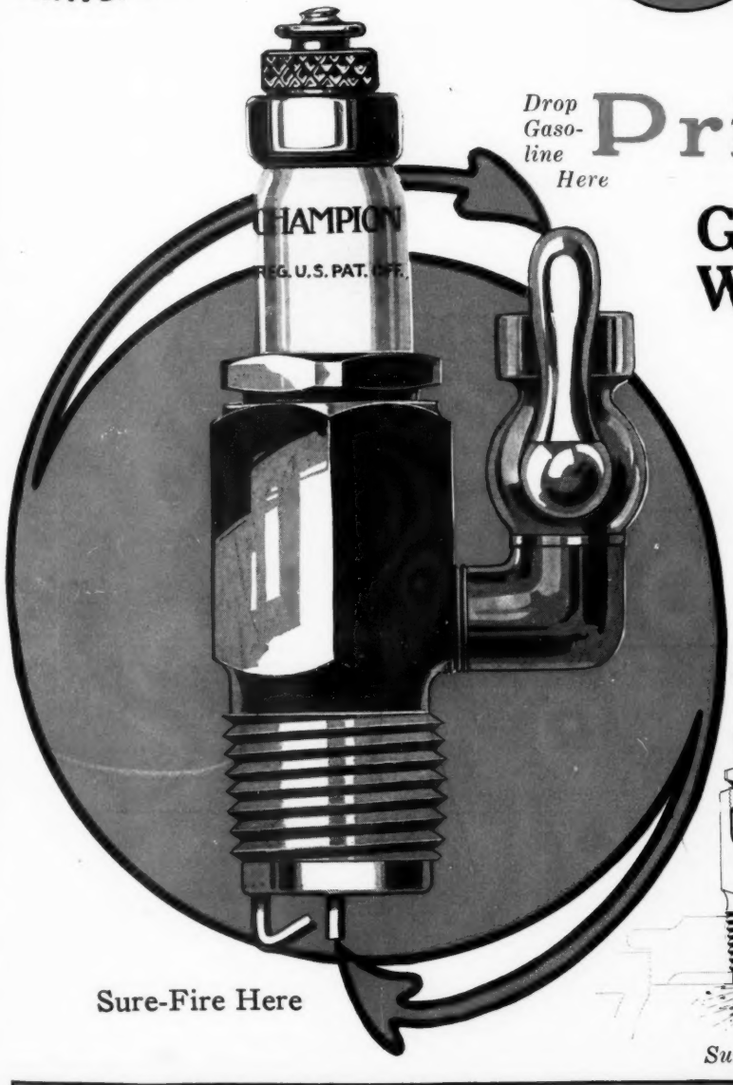

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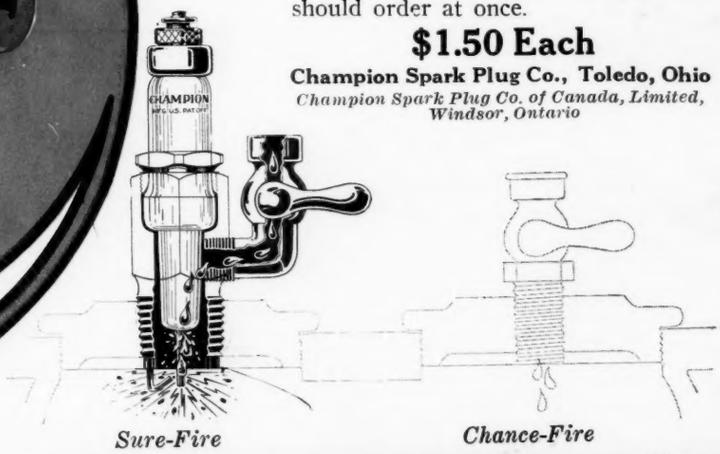

Sure-Fire *Chance-Fire*

Entered as second-class matter Jan. 2, 1903, at the post-office at New York, N. Y., under the Act of March 3, 1879.

EDITORIAL

Following Directions

ARE you one of the motorists who last winter used an anti-freeze compound in a manner which the maker of the preparation never specified and then condemned the stuff as being no good? If you did such a thing, you had better make sure that you followed directions to the letter. The manufacturers of anti-freeze compounds have met car and truck owners more than half way, and the complete directions printed on every label of their products are put there for but one purpose, and that is, to make sure the preparation will be used correctly.

OBVIOUSLY if the motorist does not do his part and merely dumps the stuff in his radiator, without following directions, he does wrong and one morning he will go to his unheated garage only to find the tubes of his radiator burst or the waterjacket cracked. The next thing he does is blame the anti-freeze substance, whereas, had he been careful to follow instructions he could have gone all winter without worrying about the cooling system.

MOST of the anti-freeze preparations have been put up in convenient form, but the amount of water in the cooling system together with the variation in temperature dictate to a considerable extent how the preparations must be used. All this is set forth in the maker's directions and in every case the big thing to watch is that the radiator has no leaks and that the hose couplings are in good shape. In fact, new hose is desirable before adding the anti-freeze, as after a season's use the inner layers become separated.

THE radiator should be washed out carefully with a solution of hot soda, which reveals any leaks that exist. These then should be soldered. Many anti-freeze substances attack dirt and sediment and if your radiator started to leak last winter after you added the anti-freeze, it was because you failed to clean the radiator and repair the leaks. The anti-freeze told you that leaks existed. You probably thought the anti-freeze was eating away the metal. Follow the maker's directions this winter and you will play safe.

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AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

VOL. XXXIX NEW YORK—THURSDAY, DECEMBER 19, 1918—CHICAGO No. 25

Development of the Aircraft Spruce Industry

Spruce Most Suitable Lumber for Wing Spars and Struts—Army Furnished Volunteer Lumbermen—Loyal Legion of Loggers Formed to Combat I. W. W. Activities

By Lawrence K. Hodges

IN August, 1917, shipments of spruce suitable for airplane construction amounted to 202,264 ft. There were no mills equipped to cut with the grain and in the two states of Oregon and Washington there were only 25 spruce mills all told.

Yet, in the following April, the output of spruce for plane construction had been pushed up to 30,000,000 ft. a month and since then even this figure has been exceeded.

This seemingly impossible result has been achieved in a manner which makes one of the brightest pages in the history of the world war.

In December, 1917, Brigadier-General Brice P. Disque realized that radical steps were necessary to keep pace with the demands of the United States and the Allies for spruce. He called a conference of five experienced mill owners and asked them if it were possible to design and build a mill which would cut spruce the right way and eliminate waste.

Four of the five said it could not be done. The fifth, H. S. Mitchell, thought it could be done. General Disque told him to go ahead. In two weeks work was started on the mill, and in 45 working days, despite the interference of the rainy season, the mill was complete and working. It is one of the largest mills on the Pacific Coast, employs 1800 men and works continuously in three eight-hour shifts.

The story of airplane spruce tells of the growth of a mere by-product of the North Pacific Coast lumber industry into a place of the first rank within one year.

Before the war Sitka spruce was cut as an incident to the logging and manufacture of Douglas fir, among which it grows in clumps, chiefly on the west slope of the coast range of mountains facing the Pacific Ocean. At that time there were in Oregon and Washington only twenty-five spruce mills, and any mill was so called of which twenty-five per cent of the cut was spruce. The lumber was used in building and in making boxes and food containers.

At the outbreak of the war the Allies scoured the world for lumber that was specially fitted for the wingbeams and struts of airplanes, and they soon discovered the merits of Sitka spruce. They began to buy lavishly, but the output was limited.

Douglas fir is the predominant timber of the Pacific Northwest and the stand of spruce is so scattered that it was not commercially practicable to cut roads into remote forests in order to reach it. Only straight-grained stock could be used, and this must be free from cross grain, twisted grain, knots or pitch.

There were no mills equipped to cut with the grain, and consequently nine-tenths of the spruce bought by the Allies was waste, though they paid as much as $250 a thousand feet for it. Yet so anxious were they to obtain it that soon after the United States declared war the British, French and Italian armies each sent an officer to the Pacific Coast to appeal to the people to get out more spruce, and the United States Government seconded their efforts.

The lumber industry of the two states was in no condition to respond to such an appeal, though good will existed without measure. The manufacturers were just emerging from a long period of depression, and many of them were not firm on their financial feet.

Obstructive Measures Inaugurated by I. W. W.

The demand for lumber for army cantonments no sooner begun than the Industrial Workers of the World, which was active throughout the lumber region, declared a strike, ostensibly for the 8-hr. day and many other things, but actually to make war on what it called "capitalism" and to obstruct war on Germany. Acts of sabotage, by which saws, machinery and food were destroyed and some mills were burned, were frequent.

The War Department attacked the difficulty by sending Colonel, now Brigadier-General, Brice P. Disque to the Coast in October, 1917, to make a preliminary survey of the situation. He was selected because of the ability which he had displayed

while in the Philippines in overcoming obstacles and in inspiring men with zeal, and later as warden of the Michigan penitentiary. He returned about the middle of November with full authority to do whatever was necessary to get out the spruce.

He applied himself first to establishment of harmony between the employers and workmen. Starting with the belief that the lumberworkers were loyal at heart and that not 5 per cent of them were convinced adherents of the I. W. W., he seized upon a suggestion which had been afloat among the manufacturers and which had been commended in the Portland *Oregonian*, that a new organization be formed among the workers bound together by the spirit of patriotism to combat the I. W. W.

Probably if the movement had been initiated by the employers, distrust among the workers would have made it a failure, but when taken up by the army it proved an amazing success.

Brigadier-General Brice P. Disque, commander Spruce Production Division

General Disque sent officers throughout the lumber regions to organize in every logging camp and sawmill a local branch of the Loyal Legion of Loggers and Lumbermen. He called for 10,000 volunteers from the army to cut spruce and they came from camps as distant as the Mexican border.

He sent these men into the woods, not only to cut spruce but to instill patriotism, or to awaken that sentiment where it was dormant. In a few months the new organization had gained control in every camp and town west of the Cascade Mountains, the I. W. W. had been put to rout and the manufacturers were so well pleased with the result that they placed the settlement of all questions of wages, hours, working and living conditions in General Disque's hands, agreeing to act upon any decision he made.

He established the 8-hr. day, raised wages, but fixed a maximum to discourage manufacturers from stealing each other's men, ordered that camps and boarding houses be supplied with good board, beds, baths and be cleaned up and kept clean, and fixed uniform rates for bed and board. His orders were cheerfully obeyed, and all went to work with good will and good feeling.

So impressed were the lumbermen of the white pine belt between the Cascade and Rocky Mountains with the success of this unique organization that they requested General Disque to extend it to their field. It was received there with as much favor as farther west, and the General was made sole arbiter in all labor questions and harmony extends through both regions.

With the co-operation of the employers the Loyal Legion now holds sway in Western Montana, Northern Idaho, and all of Washington and Oregon and has 120,000 members. The capstone was put on the structure last June when an agreement was reached to continue the organization after the war and to establish joint councils of employers and employees, local and general, for adjustment of disputes, with General Disque or his successor as sole arbitrator.

While he was getting this settlement of the labor question under way, General Disque set about increasing the output of spruce in other ways. The middle of November is the worst season of the year for logging operations on the North Pacific Coast, for it is the wet season, when rain is frequent, streams are in flood and the ground is soft and mushy; but war could not wait for good weather.

Contracts were made for purchase of spruce timber wherever it could be found in sufficient quantity and was accessible by building any kind of a road for a reasonable distance. Homesteaders were paid to cut the spruce on their claims, to rive it with wedges into cants and to haul it through the woods to the nearest railroad or highway.

But this was a temporary expedient, to be followed only until operations could be extended on a larger commercial scale. The spruce on big timber tracts was purchased and contracts were made with logging and general contracting companies to cut it and to build roads.

Financial aid was given these companies in purchase of logging equipment, rails, cars and locomotives, motor trucks and tractors, and priority was obtained for manufacture and shipment of all this material.

The troops under General Disque's command, who now number 30,000, were organized as the Spruce Production Division, and headquarters were opened in Portland, Ore., occupying an entire floor of a big business block, where hundreds of men in khaki handle one of the biggest businesses in the United States. The field of operations extends all the way from the Canadian boundary and the Straits of Fuca on the north to the southern line of Oregon, a stretch of over 600 miles.

The Sitka spruce is a shy, retiring tree, though it grows to a height of over 150 ft. to the first limb and to a girth of 11 ft., and is found deep in forests of fir.

Loyal Legion at attention

To reach the heart of the timber the Government has built 166 miles of main railroad and 103 miles of spur track. From these lines graveled, plank or corduroy roads branch into small canyons and ravines, and over them motor trucks haul logs to the railroads, long trains of trucks often being seen.

Building these roads was no light task, for the country is rough and covered with dense timber and underbrush, and clearing alone often costs $10,000 a mile. Some stretches have been built on the sides of slippery soapstone hills, others on huge tree trunks laid in parallel lines with the ties notched into them, others on piles over deep swamps and others on trestles 90 ft. high spanning gulches.

On the South Alsea Railroad a bridge 8800 ft. long containing 6000 piles has been built across Alsea

Bay, Ore., by soldiers and a few civilians. A bridge of poles 196 ft. high was built across the Skagit River, Wash., and is declared to be the highest single pole bridge in the world. Eighteen thousand soldiers have been employed in this work, including some engineers who earned $7,500 a year in civil life.

It became evident that a radical change in the methods of cutting airplane stock must be effected in order to meet the enormous demands of the United States and the Allies and at the same time to reduce the waste in shipment of stock which was rejected at the airplane factory.

Ninety per cent of the stock shipped to the Allies was thus rejected, and the waste was not confined to the lumber itself but extended to freight charges and to use of transportation facilities at a time when a famine of cars and engines had caused a fuel famine east of the Mississippi River.

Economy of the timber itself was an important consideration, for, while the statistics of the stand of spruce on the Pacific Coast look imposing, by no means all is fit for use in aircraft and, if it were cut at the rate indicated by the war's requirements, the supply would be exhausted in comparatively few years.

Where Sitka Spruce Grows

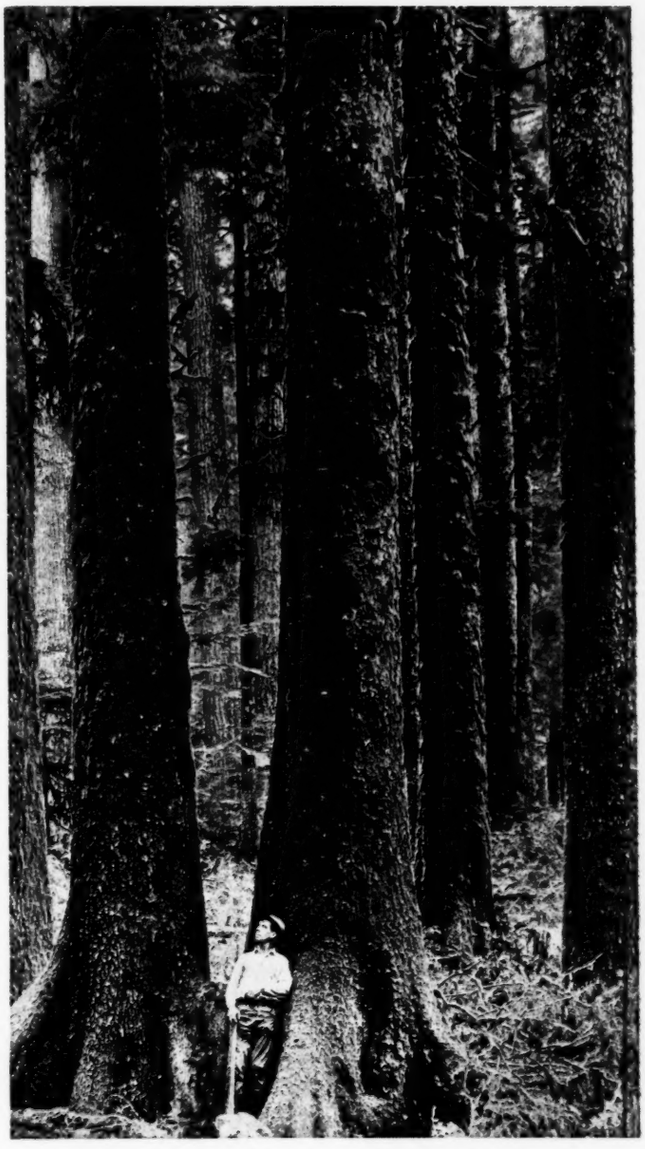
Sitka spruce grows all along the coast from the southern line of Oregon through that State, Washington, British Columbia into Southeastern Alaska. The best is found in the two States named, the total being about 11,000,000,000 ft., of which about 4,000,000,000 ft. can be reached at reasonable cost. British Columbia has more than 18,000,000,000 ft., but it is of inferior quality and comparatively little of it is accessible. Alaska has from 15,000,000,000 to 18,000,000,000 ft., but this is not so good as that of British Columbia; only about 1,000,000,000 ft. is suitable for airplanes and little of that amount is accessible.

The Government was therefore compelled to draw its supply from the 4,000,000,000 ft. of accessible timber in Oregon and Washington. This limitation of the available quantity led General Disque to seek means of obtaining from it the largest possible proportion of good stock.

He found that there were in the two States only twenty-five so-called spruce mills, any mill of which 25 per cent of the cut was spruce being so designated, but that they cut the log longitudinally without regard to the grain and had not the rigid system of inspection requisite to rejection of imperfect stock. As the grain of many logs does not run straight, which is essential in wingbeams, and as knots, twisted grain and pitch occur, this method of cutting was the main cause of waste.

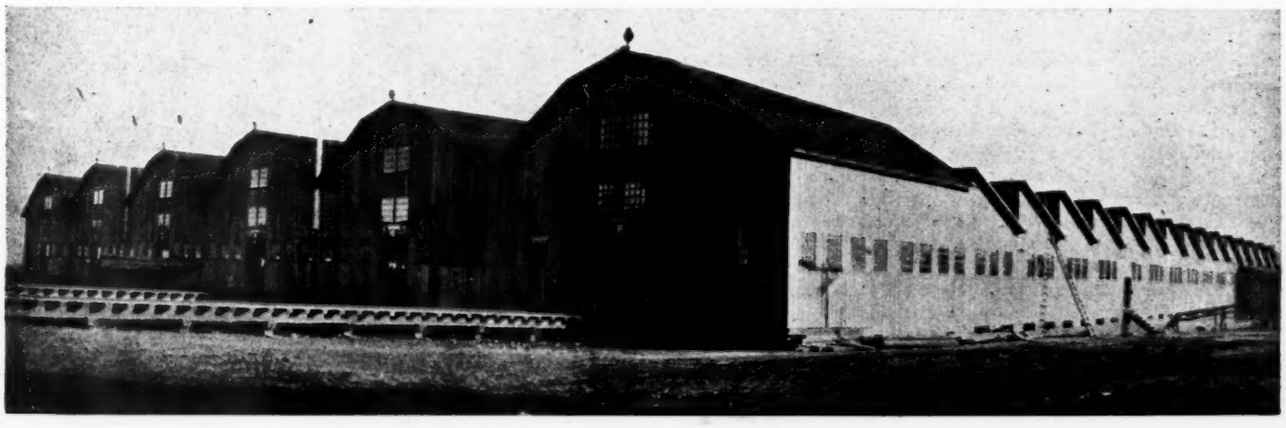
The solution of the problem seemed to be the construction of a mill specially designed to cut with the grain and, instead of shipping broad flitches of which a large part would be waste when it reached the factory two or three thousand miles distant, to carry the process still further by cutting the lumber approximately to wingbeam size, reject all defective stock at the point of production and ship only perfect stock.

With this end in view he called five experienced lumbermen into conference at Portland on Dec. 1, 1917, stated his problem to them and asked whether construction of such a mill was practicable.



Stand of Oregon spruce used for airplanes

Four of the men were doubtful, but the fifth, who was H. S. Mitchell, owner of a large mill at Wauna on the Lower Co-



General view of airplane spruce cut-up mill, Vancouver, Wash.

Riving spruce cants by hand

lumbia River, thought it could be done and made some practical suggestions.

On the following day General Disque asked Mr. Mitchell to design, build and operate a mill after his own idea, as he had had many years' experience of that kind before he became an operator. Mr. Mitchell remarked that he had a pretty big job on his hands at Wauna, but the General answered in substance:

"I have no hesitation about asking any man to drop any job, no matter how big, when the Government needs his help to win the war."

"What could I do when it was put up to me like that?" said Mr. Mitchell in relating the conversation. He dropped his job, reported for duty 3 days later and has been at it ever since, prepared to stay with Uncle Sam as long as he is needed.

Operations Proceeded Rapidly

From that day things moved quickly. Three days later lumber was ordered from 40 mills and machinery from manufacturers all the way from Portland to Cincinnati, all being shipped under priority orders. A broad stretch of level ground on the north bank of the Columbia river at Vancouver Barracks, 10 miles from Portland, was selected as the site. It was necessary to extend a spur track of the Spokane, Portland & Seattle Railroad a mile and a half, and L. C. Gilman, president of that road, was asked to lay it immediately. He said:

"I have not a foot of rail loose and do not know where I can find it, but I will get it."

He tore up some tracks in the Portland terminal yard and a week after the request was made the first carloads of lumber were delivered at the mill site. By Dec. 15 material was assembled, and work began on the foundations just 2 weeks after the project was broached to the lumbermen's committee. The rainy season was in full force, and work was suspended for a few days while the entire coast was scoured for rain clothes for the 250 men employed. Then, though rain and snow continued, construction stopped for nothing except Sundays and holidays until the mill was opened on Feb. 7, having been built in 45 working days.

The mill is one of the largest on the Pacific Coast and is the first of its kind, though others from the same design have been built by the Spruce Production Division at Toledo, Oregon, on Puget Sound, and by the British Government on the coast of British Columbia.

Trainloads of cants arrive at one side, are lifted by cranes to handcars which are pushed into the mill, and come out on the other side as perfect airplane stock to be loaded for shipment to Eastern factories. The mill is operated continuously by electric power, 1800 men being employed in three 8-hr. shifts. There are six units, the most original feature of which is a series of movable knees by which a flitch is aligned so that the saw cuts with the grain. Thus it often happens that the cut runs diagonally from end to end of a flitch. The cant or flitch passes through four operations in the process of conversion into airplane stock, and undergoes three inspections to eliminate any pieces which show defects.

Dry kilns with a capacity of 200,000 ft. a day reduce the weight of much stock 20 per cent, saving a substantial sum in freight and preparing stock for immediate use, while airdrying would occupy several months.

With the exception of a few highly skilled civilians, all the employees of the mill are soldiers who volunteered for this service. Few of them had ever seen the inside of a sawmill, and it was necessary to train crews until there were enough to operate all the six units. Men are sent from this to the other Government mills, and to instruct the crews of commercial mills which work on spruce. The patriotic soldier spirit is apparent in the zeal and skill with which they work.

(*To be continued*)

Spruce tree falling

Hair-Line Defects in Crankshafts

Metallographic Study and Physical Tests of Chrome Nickel Steel Crankshafts to Determine Nature and Effect of So-Called "Hair-Line" Defects on Their Physical Strength

By Lieut. P. J. Piccirilli

ONE factor which is the cause of much skepticism as to the strength of chrome nickel steel crankshafts is the existence of so-called "hair-line" defects. These defects appear most prominently upon the surface of finished crankshafts as very fine lines, resembling incipient checks, but they are always found to be running parallel with the axis of the shaft itself. With inspectors to whom their nature is unknown they are the cause of probably 90 per cent of the shaft rejections, the shafts being declared unsafe due to the existence of incipient checks. Since these "hair-line" defects have been the cause for so many rejections of shafts, the writer arranged a series of very accurate tests on two engine crankshafts which contained the above-mentioned defects.

In order to determine the effects of the "hair-lines," both physical and metallurgical tests were made. The tests described here were carried out at the Laboratories of Columbia University, New York, and in connection with the physical tests described it is interesting to note the method employed to measure the torque strain which permits of reading to one hundred thousandths of an inch (0.00001).

Description of Physical Tests

In order to carry out the tests in such a manner as to avoid conflicting results, two motor shafts in which "hair-line" defects existed were chosen. One of these shafts, which for the sake of convenience we shall call shaft A, was subjected to torsional moments to determine the effect of torsion upon the defective bearings, and upon the shaft as a whole. The defective bearings previously cut from shaft A, after the latter had been subjected to torsional strain beyond the elastic limit, were compressed laterally, and the effects upon the "hair-line" defects were noted. In order not to obtain confusing results, a second shaft, which we shall call shaft B, was taken, and the physical properties of the material in direct tension were ascertained from specimens secured from it. Shaft B was used for this purpose rather than shaft A because the latter already had been subjected to test. Therefore, in order to obviate the registration of any strains or stresses which had already been started in shaft A, the test specimens for determining the physical properties were taken from shaft B.

Torsion Test

In order to investigate the effect of torsional stresses upon the defective bearings of shaft A, which contained three such defective bearings, located as shown in Fig. 1, it was subjected to torsion in a Riehle torsion machine. In addition to a careful examination of the defects under torsion, complete data were obtained for plotting a "load

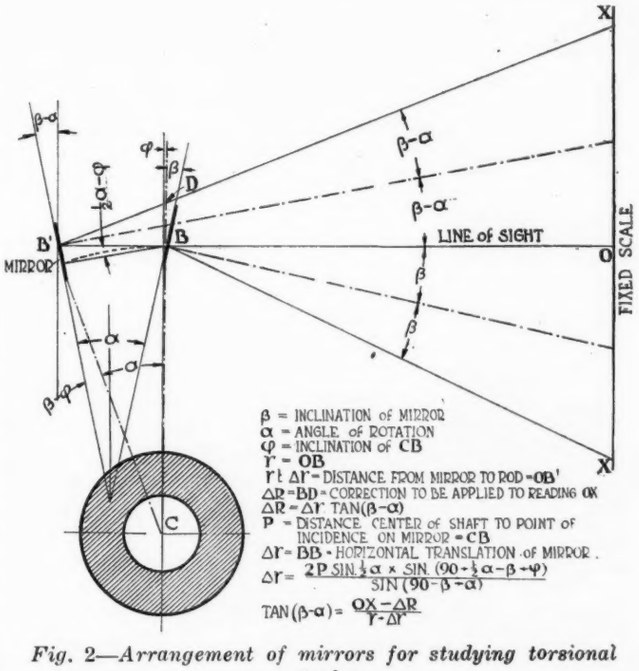


Fig. 2—Arrangement of mirrors for studying torsional strains

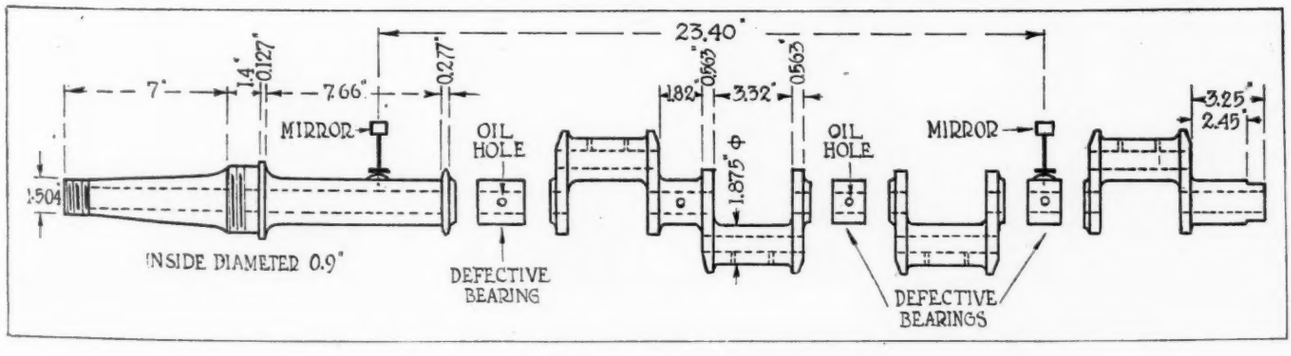


Fig. 1—Sketch of crankshaft, showing location of defective bearings

strain" curve. Owing to the irregular shape of the test specimen and the inadequacy of the ordinary laboratory methods for such important tests, the following method was used to determine very accurately the strains under various conditions of loading. Two small plane mirrors, mounted upon short steel stems and having both vertical and horizontal angular adjustments, were attached to the shaft by inserting the free ends of the stems or uprights holding the mirrors into drill holes about ⅛ in. in diameter and 3/16 in. deep and securely held to the shaft by plaster of paris (see Fig. 1). One of these mirrors was placed in bearing 2 (Fig. 1), it being impossible to place it outside of the end crank, owing to insufficient space between the end crank in the grip in the head of the testing machine. The mirror was placed as indicated in Fig. 1. The total distance between mirrors was 23.40 in. At a distance of approximately 5 ft. 6 in. from each mirror, and in a plane nearly normal to the axis of the shaft, two Philadelphia leveling rods were erected, in a vertical position. Very nearly in line with each rod and mirror an engineer's transit was mounted several feet back of the rod, and at such an elevation that when focused upon the mirror the line of sight was exactly in a horizontal plane. By means of this apparatus and arrangement of instruments, the line of sight from either of the transits directed to its mirrors was reflected back to the corresponding vertical leveling rod, when the mirrors had been adjusted to the proper angle. It is evident, therefore, that for any angular position of the mirror, it was possible to take a reading on either rod as seen in the mirrors with a horizontal wire of each transit. With mirrors clamped in such a way as to preclude the possibility of their shifting during the test, it was possible to record the slightest rotation of the shaft under varying torsional moments by the changes in readings upon the fixed scales of the leveling rods. The difference in the angular rotation of the two mirrors represents the angular displacement of two points on the shaft, a distance of 23.40 inches apart, since any slippage or rotation in the jaws of the testing machine was recorded by both mirrors. Therefore, the difference in the readings obtained of the angular movement of the mirrors was an accurate measure of the torsional strain. The tangent of the angle which either mirror makes with the vertical would therefore be equal to the rod reading, divided by the distance from the point of incidence to the rod.

Certain corrections, however, must be applied to this, because it could not be considered certain that the mirrors were exactly on the axis of revolution of the specimen, in which case they would have both a motion of translation and a motion of rotation.

Fig. 2 shows the relative positions of the shaft, mirror, rod and the transit, together with the necessary formula for reducing the rod readings to angular displacement, correcting the above described error.

Loads were applied and readings taken in increments of 5000 inch-pounds up to a load of 14,000 inch-pounds, beyond which the increments were reduced to 2000 inch-pounds. At a load of 70,000 inch pounds the increments

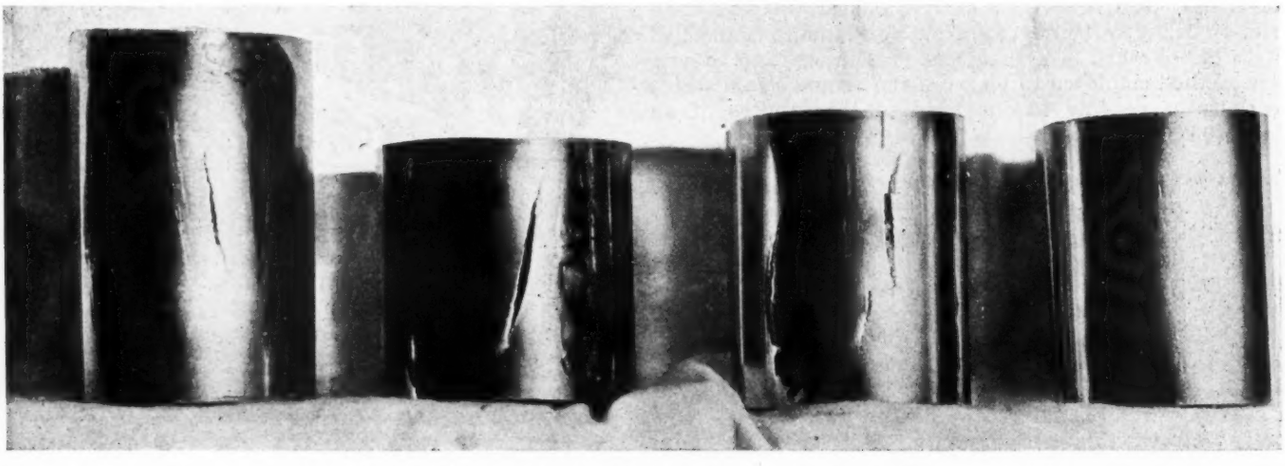


Fig. 3—Photographs of defective bearings under torsion

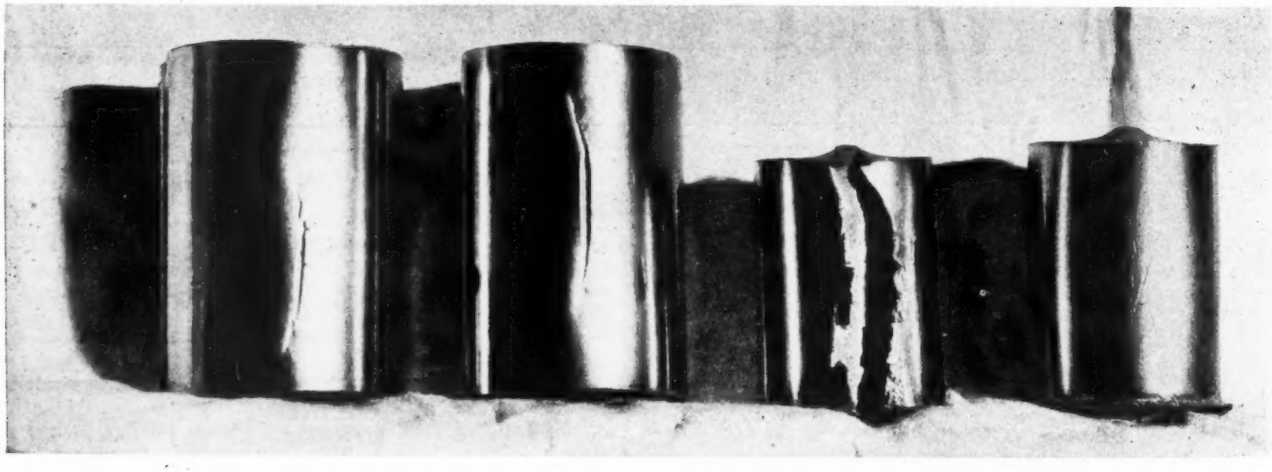
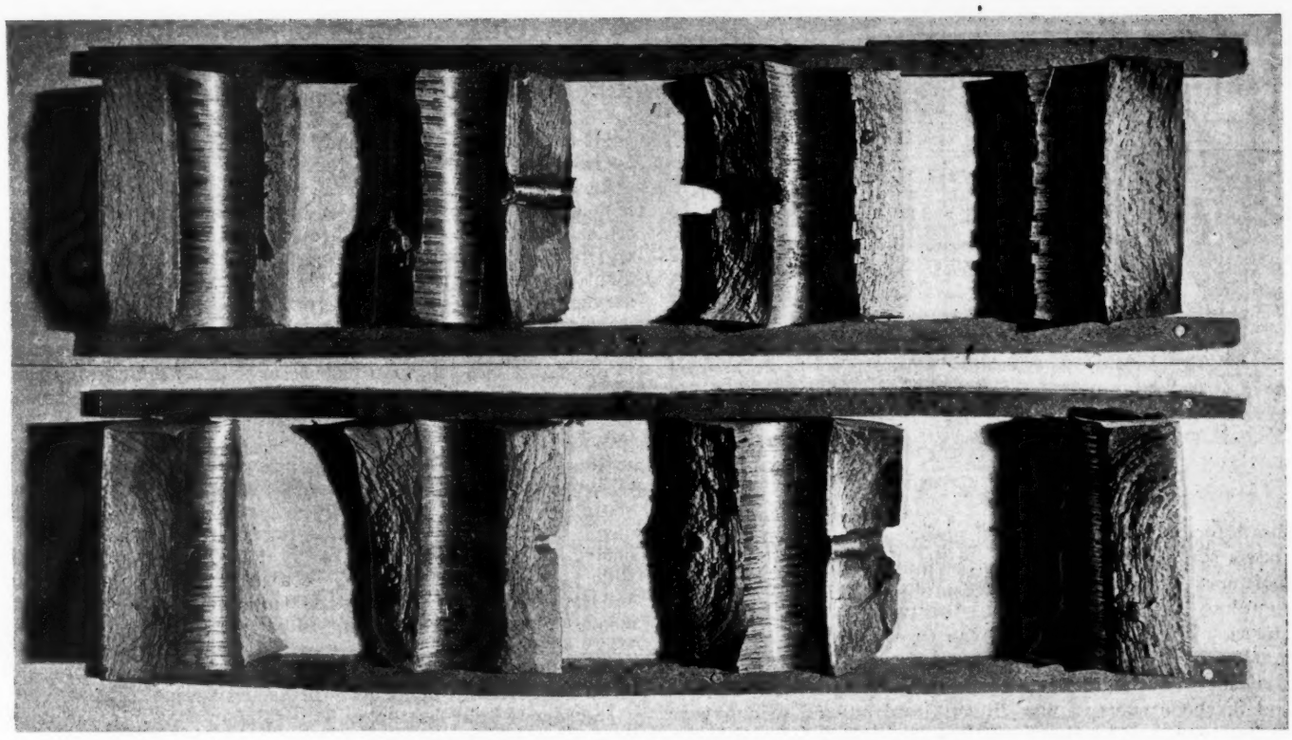


Fig. 4—Photographs of defective bearings after having been subjected to compression



Figs. 5 and 6—Fractures of defective bearings. Upper and lower views are of the same specimens, but were taken with the light coming from opposite sides

were further reduced to 1000 inch-pounds. Readings were taken to determine angular displacements of the mirrors as already explained, and the loads were read directly from the beam of the testing machine, which was accurately balanced. In order that the beam would be balanced exactly in the same position each time, two punch marks were made, one on the end of the beam and the other upon the fixed frame of the machine, between which a constant distance was maintained at each balanced load by the use of dividers. Sets were recorded at intervals of 5000 inch-pounds. Readings were continued up to a load of 80,800 inch-pounds, at which load the end of the shaft held in the head of the testing machine collapsed, making it impossible to hold the specimen and hence necessitating the discontinuance of the test. The failure at the end was due to the reduced section of metal at that point and was caused by combined torsional shear and lateral compression produced by the grips. At a load of approximately 60,000 inch-pounds the shaft assumed an appreciable set, amounting to 2 per cent of the strain at that load, but not until a load of 70,000 inch-pounds had been reached did the strain increase more rapidly than the loading. The true elastic limit of the shaft therefore must be assumed to lie between 60,000 and 70,000 inch-pounds. Assuming 65,000 inch-pounds as the elastic limit, this would correspond to a shearing stress of 53,500 pounds per square inch.

Inspection of the defective points with a magnifying glass showed that the so-called "hair-line" defects were visibly unaffected by the torsional stresses to which the shaft had been subjected and which, as already noted, was considerably beyond the elastic limit of the shaft as a whole.

After completing the torsional tests on shaft A, the bearings which contained the "hair-line" checks and which were unaffected by a torsional stress nearly 30 per cent in excess of the elastic limit were cut from the cranks. Defective bearings containing the "hair-line" checks were also cut from shaft B. Both defective bearings cut from shafts A and B were subjected to a compression test, and in no case did incipient failure begin until the specimens had been compressed beyond the elastic limit, and considerable deformation had set in. The cracks which were ultimately produced when these specimens were subjected to compression either coincided exactly with the original "hair-line" defect or formed immediately adjacent and parallel to it, ultimately including the defects. In some cases the opposite side of the specimen, free from visible marks of any kind, failed to show cracks or else showed only minute cracks upon further continuance of the compression.

Compression Tests to Ascertain Cause of Cracks

However, it was especially noted that the defective side always cracked first. To ascertain conclusively whether the "hair-line" cracks really caused the ultimate failure under consideration by reason of some incipient weakness indicated by them on the surface, compression tests were made upon sections of bearings showing no surface markings. Before compressing these, fine scratches were put on the surface with an ordinary scrib at various positions and at different angles with the longitudinal axis of the piece.

This was done to determine whether upon deforming this piece artificial scratches on the surface would control the location of the crack formed under compression. Out of four cases only one of the cracks formed by the compressive stresses coincided with the surface scratch made by the scrib. All the others appeared to be entirely independent of the existence of such scratches on the surface. However, including all of these tests, it must be stated that no indications of cracks due to compressive stresses were noticed anywhere until the specimen had deformed considerably.

Figs. 3 and 4 show clearly the extent and nature of the above-described cracks produced on the specimens when subjected to compressive stresses. Fig. 4 shows

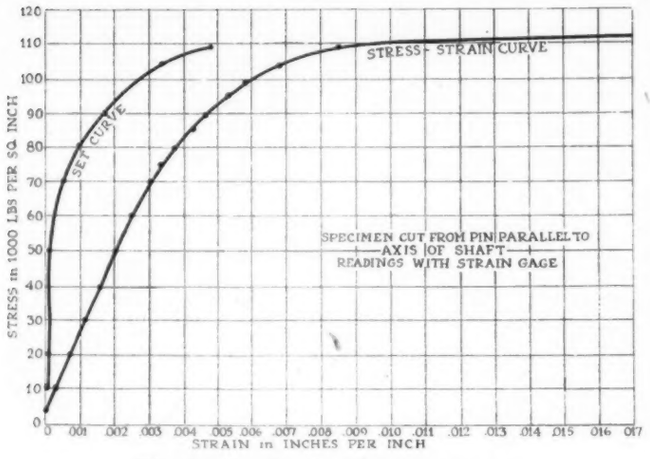

STRESS + STRAIN CURVE
SET CURVE
SPECIMEN CUT FROM PIN PARALLEL TO AXIS OF SHAFT
READINGS WITH STRAIN GAGE
STRESS in 1000 LBS PER SQ INCH
STRAIN in INCHES PER INCH

Fig. 7—Tensional stress-strain curve

the defective bearings tested under compression. Fig. 3 shows the perfect bearings artificially scratched. In two instances the compression test was purposely carried to complete failure, when the specimen broke into four pieces. The object of this was to enable a closer examination of the longitudinal fracture and a study of the structure of the material. As will be noted in Figs. 5 and 6, the structure was fibrous and curved or wavy in appearance, producing a rather twisted fracture. The reason for this particular type of fracture in chrome nickel steel shafts will be explained in the latter part of this article, dealing with the metallographic study of the material of the shaft. Figs. 5 and 6 are two photographs of the same specimen with the light on different sides.

Tension Tests

As previously stated, tension tests were made, irrespective of the defective points, to investigate the elastic properties of the material. The first test was made upon a specimen taken from the propeller end of the shaft, and was of the original diameter and shape. This piece was comparatively short and after allowing for the necessary length to be held by the grips only 3 in. remained clear between grips. Two sets of gage holes, 2 in. center to center, were drilled into the piece on opposite sides of the bar, so that strain gage readings could be taken. A 2-in. Berry strain gage was used to determine the strain produced on the piece at varying loads. Unfortunately failure took place outside the gage marks, and just inside the upper grips, thus preventing a representative determination of the proportional elastic limit or of the elongation. The maximum load carried was 213,000 lb. or 100,100 lb. per sq. in. Fig. 7 shows the readings obtained. The fracture produced was mostly silky, except for a small area, which was crystalline, probably caused by a slightly eccentric loading due to the slippage of the grips on the specimen.

(To be continued)

Germans Using Wood Tires

A CORRESPONDENT of *L'Auto*, giving particulars of German transport vehicles captured during the recent Allied advance, says every vehicle has wooden tires, as no suitable substitute of an elastic nature has been discovered to counteract the rubber shortage. The tires on the front wheels are of the same section as the rubber tires usually fitted to French transport vehicles, but the rear tires are of a very flat section, 8 in. to 10 in. wide, and 4 in. to 5 in. thick. A detachable rim enables the wood tire to be changed, an operation which should be fairly frequent. The treads are grooved to reduce slipping and promote a grip of the roads.

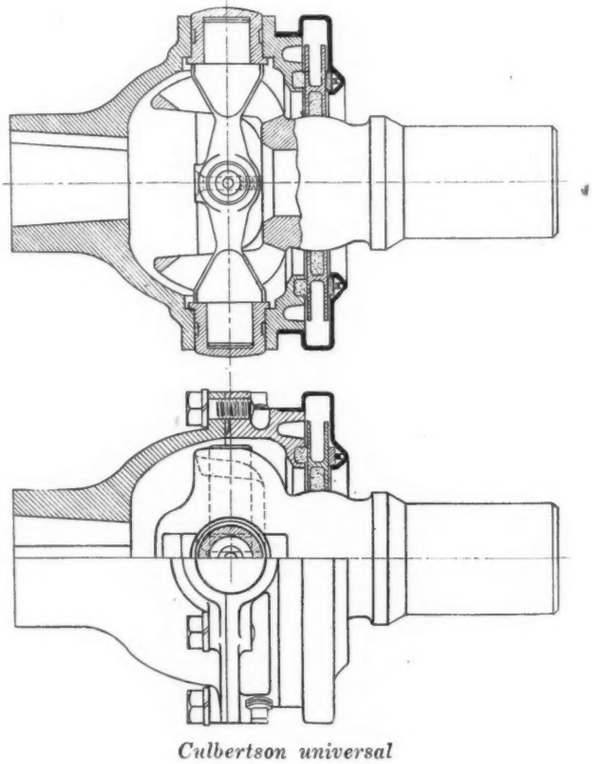
Culbertson Universal Joint

E. ESTAY CULBERTSON, Detroit, Mich., has developed a universal joint of simple construction, and which can be lubricated by means of oil. Two sectional views of the joint are shown herewith, and the principle of the device will be readily understood from these illustrations.

Instead of the conventional driving and driven flanges, Mr. Culbertson employs a one-piece hemispherical member which transmits the torque through bushings to a driving pin, which in turn transmits it to the driven member. There is also a central pin, perpendicular to the driving pin, which serves merely to locate the driven member. This central pin is held to the driving pin by means of a machine screw. The hole in the driving pin at this point is about 0.004 in. greater in diameter than the pin, this clearance being allowed in order to provide for wear upon the flat bearing surfaces of the driving pin. A wear of from 0.006 to 0.008 in. at the flat bearings is thus provided for.

One of the features of the joint is such an inclosure that oil lubrication is rendered possible. Instead of using the conventional spherical type of wiper, Mr. Culbertson provides a novel form of housing. It comprises a vertical slide supported on a spherical surface on the driven member. This slide is being pressed against a cork packing, lodged in the end face of an annular casting bolted to the hemispherical member, the spring pressing directly against a fiber disk. Mr. Culbertson's object in using fiber at this point is to obviate all noise. The surface against which the packing for lubricant retention operates is protected against dirt.

In order to hold the parts of the joint in assembly, the same as in the conventional construction, the holes for the bushings are drilled with their centers not in the parting flame but 1/16 in. to one side thereof, in the annular casting. This makes the opening of the hole virtually 0.007 in. smaller than the diameter, and the bushing is pressed into this casting and is firmly retained in place. This permits of removing the hemispherical member from the joint without disturbing the assembly of the remainder. The driven member is drilled out from the end, in order to save weight. The construction calls for only two bushings, and there are parallel bearings on the driving pin. The slot in the driven member is made by simply pushing this part against a milling cutter.



Culbertson universal

Status of the Unproductive Worker

Are Not Salaried Workers Equally Entitled to Representation in Organization with Skilled and Unskilled Employees?

By Harry Tipper

THE attention of industrial organizations has been directed to skilled and unskilled workers engaged in the actual manufacture of the product by the activities of the organized bodies of labor and their constant appeal for public attention to such an extent that there is some danger of losing sight of the army of other workers whose demands are less vociferous but whose case is none the less important.

It is interesting to note that in some of the organization plans which have admitted the general body of labor in the establishment to a share in the responsibility for their own conditions a specific statement is made that *no salaried employee of the company shall be entitled to a vote in the election of the representatives of the working body.*

A number of individual plans have been made in the last 10 years, and particularly in the last 4 years, in various lines of industry, but very few of these plans seem to have recognized the bodies of employees who are not supervisors, who have no responsibility in controlling the operations, and who are equally important with any other bodies of labor as individuals, and equally necessary to the success of the organization.

It is true that for the most part these workers are not organized, and any demands which they have made have been of an individual character; they are not paid by the hour; and as a rule they do not receive extra pay for overtime. It is also true that the turnover of such labor is comparatively small, the permanency of occupation is very much greater, and the general tendency to stable conditions of work and of wage makes the problem an entirely different one.

Reasons for Neglect of Some Workers

The reasons for this apparent neglect of a considerable body of workers in the systems of representation which are being considered and adopted by a number of concerns can be readily stated. The lack of organized protest has resulted in a lack of public attention. The stable character of the work and the orderly necessities of such work have produced dislike for the methods of skilled and unskilled labor protest which are evidenced by the failure of the occupational organizations of labor in this country to extend themselves into these fields.

Attempts have been made from time to time to organize one occupational branch or another of these workers without any success. It is natural for us all to consider those difficulties which are constantly brought to our attention, and in business the justification of the organized labor leader lies in the fact that the demands of organized labor, no matter what their justice, have resulted quite continually to the advantage of those branches of workers.

From the manufacturer's standpoint, however, any system of legislative organization in his whole industrial unit which places the workers who are engaged in actual production in one category and the supervisors or governors in another, bringing these two together with a joint system of responsibility and discussion, but fails to recognize the necessities of the somewhat smaller body of workers who are neither supervisors nor engaged in the actual production—any such system cannot work out to the fullest advantage because it will eliminate from the discussions and from the responsibility of decision those workers who represent an orderly and valuable part of the industrial unit.

It is not so much a question of justice being done to this part of the organization, although it would be possible to show there is just as much necessity for an examination of this point, but it is the question of the value of this part of the working organization in the discussions of the legislative requirements.

Perhaps these workers represent the individualism which must be retained to an extent if the organization is to live, and their traditions of service, as well as their social surroundings and general habits of living, induce them to regard without entire approval the general movement toward purely collective action.

Not Benefited by Continual Protest

They have not been benefited by the continual protests of organized labor; in fact, the increased wages and the improvement of working conditions in the factory have at times militated against their own economic advancement.

On the other hand, they have not been served with such notable justice by the employer that they are sympathetic with his viewpoints, or to be regarded as his representative. In general they have paid more for the training which precedes their service and received less for the years of their service than the skilled workers who have organized themselves into occupational units.

Their point of view in the organization policies which would be recommended by the legislative bodies of workers and supervisors together would be of very great advantage in placing the wage system upon a proper basis and in the consideration of conditions of work.

Furthermore, the exclusion of this body from the general considerations which come up before the legislative and judicial machinery established within the industrial unit must inevitably arouse discontent, a weakening efficiency, an increased turnover, and, finally, result in the loss of good material from these branches to the ranks of the skilled and unskilled laborers who form a part of the actual production force.

It is true that schemes of old-age pensions, continued salary during sickness, continued work during times of depression, have been usual in a good many organizations for this branch of the working force, and to that extent in the stability of the labor they have been treated with less rigor.

It is also true that the stability of their wages during times of depression must be compensated for by less advance in times of prosperity. It is nevertheless clear that if a careful analysis be made of the extent of the training required to produce efficient workers in these

occupational branches, and a careful examination be made of their importance, in comparison with the more active occupational branches of the workers, that *they have not received the attention that should be given to them by the manufacturer in the interests of his own efficiency and full content in his own organization.*

If we accept unconditionally the belief that control in industry should be vested in the stockholders, and exercised by the elected officers of those stockholders, and that labor is a commodity to be secured like other commodities at whatever price it is necessary to pay, then these considerations are without any bearing.

There is little danger of organized effort on the part of these workers to attract public attention in the immediate future, and although their sympathies are quite frequently with the other workers because of a natural similarity in aspiration, they are usually more conservative in their actions and not likely to be so readily caught up in radical movements.

If we accept, however, the position which has been taken by many industrial leaders of foresight and prominence, that labor is not a commodity but a human service, exacting in its fulfillment the very life of the worker, and demanding a consideration of the individual economic, social and political aspirations, these very facts should in themselves indicate the necessity, and indeed the advantage, of instituting organization plans which shall include this valuable part of the industrial group in some effective way.

Consideration of Essentials of Co-operation

If we go further and accept what has been stated by some of the most discerning and successful of the industrial organizers in the last two or three years, to the effect that a reasonable degree of the spirit of co-operation, a thorough incentive and some measure of understanding will increase the economic value of the individual worker, then the necessity for the consideration of these neglected branches of the working body becomes apparent.

It is obvious that the tendency which was forecast in 1915 in the writer's book "The New Business" to invite the worker to exercise a greater responsibility in the determination of his working conditions is becomng manifest in the actions of a number of large and successful organizations which have adopted plans of this kind.

It should be equally obvious that any such organization plans should take in not only the skilled and unskilled workers who are engaged upon actual production but that equally important, although smaller, body of workers who are for the convenience of industry paid what is termed a salary and whose working conditions are more stable, but who are not concerned with the control of the operations or with the supervision of other labor.

It is true, of course, that the representation from such workers would have to be worked out in a somewhat different way from that which is usual in the organization plans providing for the representation of the skilled and unskilled workers who are engaged in the actual productive work.

In such an organization plan, for instance, as that which was discussed last week of the Midvale Steel & Ordnance Co., the number of such workers in any one of the plants might not be sufficient to provide them with a representative from their own ranks on the same basis as prescribed for the workers in the mill.

The question would have to be considered in each case as to whether it were desirable that they should be entitled to a vote along with the other employees specifically named in the organization plans or whether a change in the representation should be made to permit of their securing a representative from their own ranks to sit upon the joint committees.

The plan of the Colorado Fuel & Iron Co., which is similar to the other plans in the steel business, states specifically as follows:

"Shall state that employees being wage earners in the employ of the company at the time of the meeting and for at least three months immediately preceding, but not salaried employees, shall be entitled to be present and vote." This means that the laborer of whom the company knew nothing and who had no interest in the company four months before the voting date can vote provided he arrived at the camp and was put to work three months before that time, whereas the man who had been paid to act as stenographer or record clerk at the same camp, and has been in the employ of the company for 10 years previous to the time of the vote, is specifically eliminated from voting because he has been paid on a weekly salary instead of on a time card.

It would be unwise, in the attempt to allay discontent, by providing a co-operative organization, to transfer that discontent from the ranks of the skilled and unskilled wage earners to those employees who have been, up to the present, the more stable branches engaged upon the necessary work of the industrial unit.

It is obvious that in no representative system adopted for organization purposes should any supervisor of labor or direct representative of such supervisor be included in the voting population for men who are to represent the employees of the organization, but this reason does not seem to be sufficient to eliminate all employees working on a salary without regard to their position and responsibility.

The fact of the matter is that there is no particular problem here at any one moment; there is no question of the stoppage of production or of general strikes; there is no distinct tendency to disorganization, and the thought has been put largely upon the problem and not thoroughly upon the principles behind it.

Organization Should Begin with Details

It is well that, as stated previously, new organization plans of this kind should begin with small matters and gradually develop into the handling of the larger problems; but the machinery of the organization should be established in such a way that it can take care of practically every possible problem which may come up as it grows together and functions properly.

No organization can do much good unless the spirit of co-operation is there, and the spirit of co-operation must be shown first by the employer in his organization plans; but no organization plan can develop the spirit of co-operation thoroughly where it begins by eliminating a certain body of workers or a certain portion of the working force from participation in its actions and from a sense of unity with it.

The reason why organization plans such as we have mentioned are being adopted by concerns every few days is to be found in the necessity for common responsibility where there are common interests. The organization of industry was divided by the system of labor unions and by the increasing solidarity of labor, and these plans have been adopted to eliminate the division and bring the whole body together in common purposes.

It is a little surprising, therefore, that some of them should have specifically eliminated from this common responsibility a body of workers whose interests are no less important in the organization unit and whose incentive and content are just as necessary to the proper productive efficiency.

Air Flow Through Poppet Valves

An Experimental Investigation of the Resistance to Gaseous Flow Through Poppet Valves of Different Diameter and Lift— Single Versus Double Valves

AMONG the problems which have confronted explosion engine designers for some years is that of the dependence of air flow or gas flow through poppet valves upon the valve diameter and lift. This question comes up in a consideration of the advantages of double valves or four valves per cylinder, as now used in some automobile engines and many aircraft engines. It has not been definitely known in the past whether the flow for a uniform pressure drop would increase directly as the diameter and as the lift, and this made it impossible to make a comparison, on theoretical grounds only, between the capacity of two small valves of given dimensions with one large valve.

Considerable light has been thrown on this problem by an investigation made by the Clarke Thomson Research, under the direction of the National Advisory Committee for Aeronautics, the results of which are embodied in Report No. 24 of the committee, just published.

The apparatus used in the tests consisted principally of a centrifugal blower, a model cylinder and U tubes for measurements of pressure. The blower was one of special design with a balanced rotor 11.25 in. in diameter, composed of 10 forward curved blades. An electric motor furnished the power, rheostat control permitting speeds from 3000 to 6500 revolutions per minute, corresponding approximately to pressures of 9 to 32 in. of water. The number of impulses varied from 30,000 to 65,000 per minute, affording practically continuous flow. The blower was connected to the cylinder with rubber hose, care being taken to see that the alignment of the hose remained perpendicular to the face of the cylinder at point of entrance throughout the tests.

Dummy Engine Cylinder Used

The cylinder is shown in longitudinal cross section in Fig. 1. The cylinder head was carved out of white pine and carefully finished. At the entrance end, the passages leading to the valves were cylindrical in form with axis perpendicular to the cylinder axis and 2.5 in. in diameter, the passages then curved as shown to the ports. The approach to the large valve, which had a diameter of 2.5 in., was circular in cross section at all points. The approach to the pair of valves on the opposite side of the cylinder became narrower in the plane of the cross section shown, and widened laterally to smoothly divide, about 1.5 in. from the ports, into two passages of 1.75 in. diameter. The angle between the valve axis and the cylinder axis was 15 degrees. No valve guides or bushings extended into the passages.

The diameter of the counterbore was 5.75 in. and of the cylinder proper 5 in. The valves were seated with a bevel of 30 degrees in the two planes forming the cylinder head. The diffuser shown was constructed of thin brass soldered together and inserted so as to divide the whole area of the cylinder at that point into rectangular passages about ⅞ in. square and 2 in. long.

The jet at the opposite end of the cylinder was likewise carved out of white pine as shown, and was connected to the cylinder head by a length of 5-in. wrought-iron pipe, smoothly galvanized inside, used to obtain sufficient length for rectification of the air current. Gaskets and shellac were used at the joints and the assembly drawn together with four long bolts extending from end to end, outside the cylinder.

Three Sizes of Valves Tested

In addition to the single valve with a diameter of 2.5 in. and the pair of valves with diameters of 1.75 in. already mentioned, another pair with diameters of 1.25 in. was tested. False seats were used with this smaller pair, consisting of turned hardwood rings, carefully fitted to the 1.75 in. seats and beveled to receive the smaller valves. These false seats obviously left a circular shelf or projection 0.25 in. wide immediately above the ports. As a matter of interest, two readings were taken with these shelves projecting above the port, but before running off the main test on these 1.25-in. valves, the lines of the passages were smoothed off by filling in above these projections with putty.

The valves were all designed on similar lines with the exception that the smallest pair had stems 5/16 in in diameter, to fit the guides used for the larger pair, this dimension being

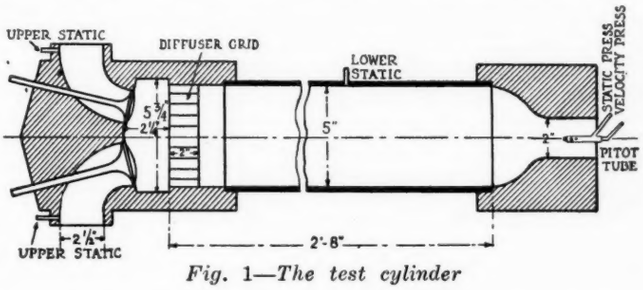


Fig. 1—The test cylinder

40 per cent larger than true proportion dictated, equivalent to a reduction of 0.022 sq. in. or 1.8 per cent of the port area of the smaller pair.

The Pitot tube shown in the jet in Fig. 1 was clamped in position at the axis of the jet throughout the tests, velocity readings being taken as later described. The dimensions were 3/16 in. outside dia. and about 2.5 in. in length. The impact end was gradually rounded and the static holes were four in number, about 0.02 in. dia., smoothly perforating the outer wall.

A static tube of ⅛ in. dia. penetrated the central portion of the cylinder, reading static pressure of the air column after passing the valves and the diffuser. This is for convenience termed the "lower static."

Static tubes of ⅛ in. dia. also tapped the flow where the air column entered the passage leading to the valves. These are for convenience termed "upper static," only one being used at a time, as indicated by its position with respect to the valves. All statics were slightly rounded on the inner periphery, and the end kept flush with the inner surface of the cylinder or passages, and so located as to be perpendicular to the direction of air flow.

The upper and lower statics were connected to the two legs of a U-tube to read directly the pressure drop through the valve, and also connected to other U-tubes to read the upper static and lower static head separately.

All U-tubes had an inside diameter of about 0.25 in. and were vertical with the exception of one, which was inclined at a slope of 10 to 1 to read with greater accuracy velocity pressures of 3 in. or less.

A centigrade thermometer was clamped with its bare bulb in the air jet at a point about 1.5 in. outside the apparatus. A similar thermometer was hung on the wall for readings of room temperature.

The moisture content recorded is the average for the period indicated, as taken from a recording hygrometer, the variations being but slight, as were those of the barometer.

It is not necessary here to give a full explanation of the methods of measuring the velocity and quantity of air as

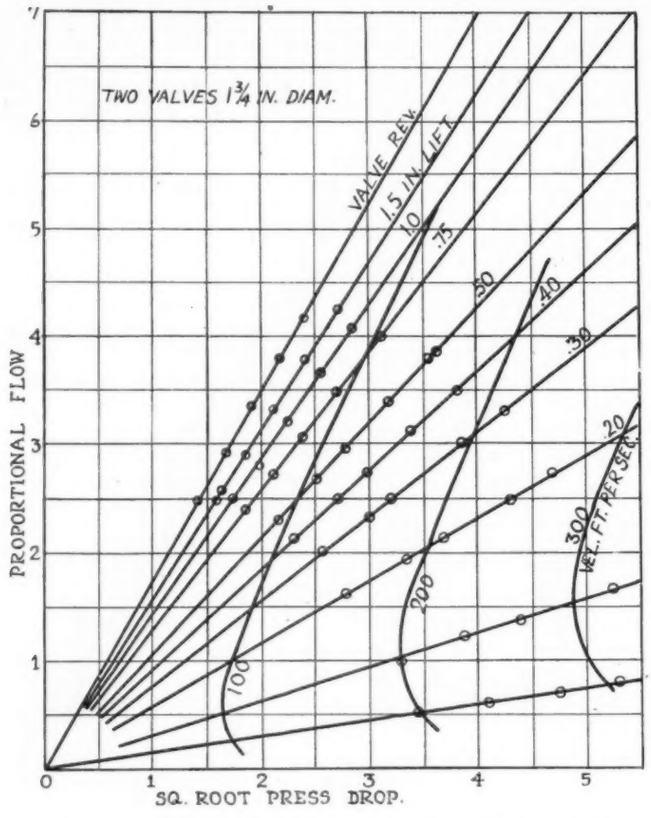


Fig. 2—Variation of flow with pressure drop and lift

given in the report. The results are embodied in tables and diagrams, but only the latter are reproduced here.

The purpose of this investigation was primarily to secure comparatively accurate comparisons as between the capacities of the different valve combinations, rather than to secure absolute quantitative determination of the flow in any case. It will readily be seen that the velocity and quantity of air flowing through the jet at the outlet of the system will be proportional to the square root of the velocity pressures read by means of the impact tube in the jet. The vertical scale of the following graphs is based on these readings and is termed for convenience "proportional flow."

Pressure Drop and Flow Graphs

The horizontal scale is laid off to the square root of the pressure drop through the valve combination tested, which is deemed much preferable for the present purpose to the use of the pressure drop itself.

Wherever "proportional flow" is used as a basis for plotting in the various plates shown, it should be remembered that this refers to flow through the same jet in all cases, without respect to the valve opening or pressure drop causing the flow, and that the various results so obtained may therefore be directly compared, owing to the use of this jet as the common medium of measurement in all tests.

As to Fig. 2, it is true that the scale is small and that plotting to square roots tends to reduce the magnitude of any irregularities in the points obtained, but the close coincidence of the points with the straight graphs passing through the origin seems to warrant the conclusion that the actual velocity through the valve at any given lift varies directly with the square root of the pressure drop, at least within the limits of these tests, as does the theoretical velocity. It further follows as a general rule within these limits that the coefficient of efflux does not vary with the pressure drop. Certain limitations upon this conclusion may be required, however, and will be discussed in connection with the graphs showing the variation of the coefficient of efflux with the lift.

Curves of equal velocities have been superimposed upon the graphs of Fig. 2, to show the approximate velocities through the valves in feet per second. At about the average conditions of the tests, namely, 80 deg. F., 55 per cent humidity, 68 deg. wet bulb, and 29.72 in. barometer, air weighs 0.0717 pounds per cubic foot. Inserting this value in the equation $V = 18.275\sqrt{p/w}$ gives $V = 68.2\sqrt{p}$. In other words, assuming air at this density, multiplying the vertical scale by 68.2 gives actual velocity through the jet in feet per second, and applying the same correction to the horizontal scale gives *theoretical* velocity through the valves. The actual velocity through the valves may then be obtained either by applying the ratio of areas to the vertical scale of jet velocities or by applying the proper coefficient of efflux to the horizontal scale of theoretical valve velocities.

Curves representing actual velocities of 100, 200 and 300 feet per second through the valves have been laid off by the former method and agree fairly with results obtained by the latter method, except as to irregularities in some of the points used for plotting the coefficient curves later presented.

These curves may be used to approximate the actual pressure drop necessary to produce a given velocity. For example, in Fig. 2 it is seen that the pair of 1.75-in. valves with 0.20 lift indicates a velocity of 200 feet per second at the ordinate corresponding to 3.55 in the horizontal scale or 12.6 in. of water or 0.455 pounds per sq. in. as the required pressure drop. It should be noted that these velocity curves are merely approximate and that errors up to 5 per cent or so may be found.

Variation of Flow with Valve Lift

It is evident that the intercepts on any ordinate on Fig. 2 will represent the variation of the flow with the valve lift at the pressure drop corresponding to the ordinate selected.

Fig. 3, lower chart, presents such curves for the three valve combinations, plotted from intercepts on the ordinates corresponding to a pressure drop of 16 in. of water, the ordinates numbered 4 in the square root scale. The curve of flow for the single 2.5-in. valve lies between those of the pairs of valves at all lifts. It is found to be very nearly equal to that of the smaller pair for low lifts and approximates that of the larger pair at the higher lifts.

These curves are plotted against valve lift in inches, but for convenience the points equal to one-quarter and one-half diameter have been marked on each curve. By interpolation between these points and others similarly located, the approximate curve of flow for two valves of 1.5 in. dia. is presented. This indicates a flow quite closely equal to that of the single 2.5-in. valve up to a lift of about 0.6 in.

Lift in inches.....	0.125	0.25	0.375	0.500	0.625	0.750
2 valves, 1.75 inches..	137%	129%	125%	119%	116%	113%
[1] 2 valves, 1.50 inches.	114%	106%	101%	94%	90%	87%
1 valve, 2.5 inches....	100%	100%	100%	100%	100%	100%
2 valves, 1.25 inches..	85%	77%	72%	65%	59%	54%

[1] Interpolated.

The points connected to the curves by broken lines indicate, to vertical scale only, the flow with the valves reversed. This might be considered equivalent to the flow with the valves at an infinite lift, which agrees with the horizontal trend of the curves, but more practically, these points represent the maximum limit of flow through the respective ports at this pressure drop. These curves, comparing performance upon a basis of equal lift in inches, are particularly applicable where it is conceded that mechanical features generally limit the possible lift regardless of valve diameter.

On the other hand, it is often asserted that the proper limit of valve lift is a function of the diameter, and for purposes of comparison on this basis Fig. 3, upper chart, has been prepared from the curves last discussed, changing the horizontal scale to read in per cent of the diameter of each valve. In the case of pairs of valves, the flow of both is plotted against the lift, expressed in per cent of the diameter of one valve only.

The result of this transposition is at once apparent. The intercepts on an ordinate very closely agree with the proportionate cross-sectional port areas of the several valve combinations, and in the case of the two curves corresponding to valve combinations with equal cross-sectional port area,

the curves coincide within the probable error of the work. Up to a lift of 0.5 dia. the coincidence is all the more exact if it be remembered that the two 1.75-in. valves have an area about 2 per cent less than the single 2.5-in. valve.

From this it would appear reasonable to infer that under fairly similar conditions different valves or combinations of valves have capacities in proportion to their respective cross-sectional port areas, when the lift in each case is same per cent of their respective diameters.

It also seems logical to infer that the theory of the hydraulic mean radius has but little application to the losses in poppet valves, it being more properly applicable to what may, for convenience, be termed surface friction, or actual rubbing of the moving fluid upon the surrounding wall, whence its derivation—the relation of cross-sectional area to perimeter in contact with the moving fluid.

It is evident from an inspection of the curves in Fig. 3 that a lift equal to one-quarter diameter develops less than 67 per cent of the full capacity of the port, and that a lift of one-half diameter develops 80 to 90 per cent of the full capacity.

Coefficient of Efflux

The coefficient of efflux is taken as the ratio of the observed mean velocity through the valve to the mean velocity which would theoretically result from an equal pressure drop. Assuming that the temperature, density and humidity of the air are the same at the valve as at the jet, this coefficient may be obtained directly from the relation of the areas and the proportional velocities observed. The proportional velocity at the jet multiplied by the ratio of the jet area to valve area gives the proportional velocity through the valve. If the ratio of this velocity to the square root of the pressure drop be taken, the result is the coefficient of efflux. To be more exact, this should be multiplied by 0.99, the coefficient of the jet.

The above short method may be justified by developing the usual equation $V = \sqrt{2\,g\,h}$ in the units here most convenient:

V = velocity in feet per second.
g = acceleration constant of gravity in feet per second.
h = head of air in feet causing the flow.

Substituting the head in inches of water:

$$V = \sqrt{2\,g\,p\,\frac{62.31}{12w}} = \sqrt{2\,g\,p\,x\,\frac{5.192}{w}} = 18.275\sqrt{\frac{p}{w}}$$

where w is the weight of water in pounds per cubic foot, 62.31 is the weight of water in pounds per cubic foot, and p is the pressure head in inches of water.

This equation is deemed sufficiently accurate for the low pressures here subjected to examination.

Now, if A = the jet area, and
a = the valve area,

the mean velocity through the valve is $18{,}275\frac{A}{a}\sqrt{\frac{p}{w}}$ where p is the velocity pressure and w the density of the air at the jet.

The theoretical mean velocity through the valve is $18.275\sqrt{\frac{P}{W}}$ where P and W are, respectively, the pressure drop and the density of the air at the valve.

$$\text{The Coefficient of Efflux} = \frac{18.275\frac{A}{a}\sqrt{\frac{p}{w}}}{18.275\sqrt{\frac{P}{W}}} \text{ or } \frac{A\sqrt{p}}{a\sqrt{P}}$$

where the density of the air is the same in the jet and in the valve.

Basis for Valve Area Calculation

In computing the coefficient the valve area has been taken as $\pi D\,h$ for all lifts. It is realized that for small lifts the aid of trigonometrical formulæ may be invoked to determine accurately the least area of opening, but the same formulæ are not applicable at higher lifts. Moreover, they are only justifiable upon the theory that the lines of flow are parallel, which does not obtain for any except the smallest lifts.

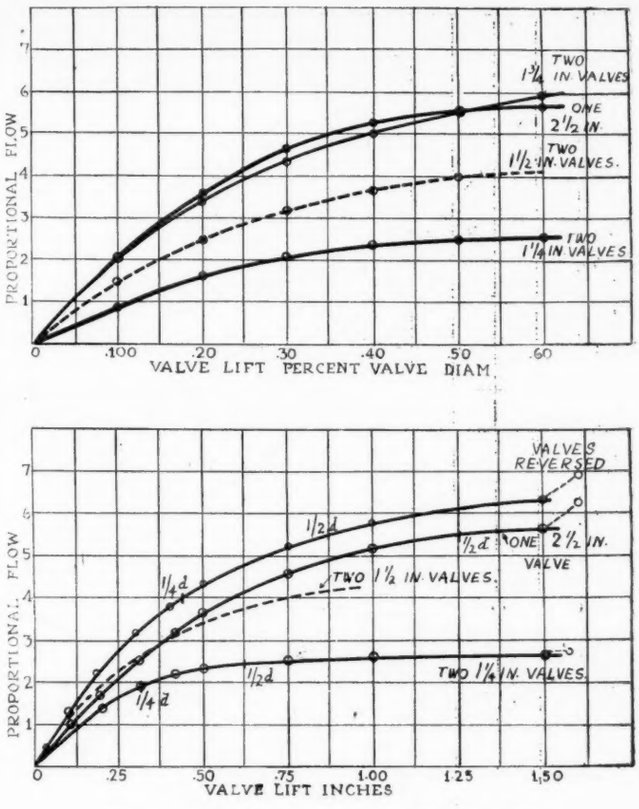


Fig. 3—Variation of flow with valve lift

In Fig. 4 the coefficients of efflux will be found, plotted against valve lift in the lower chart, and against lift in per cent of diameter in the upper. These coefficients are considerably higher at low lifts, a feature somewhat difficult to explain satisfactorily. Both friction and dynamic losses should be greater at low lifts, as the ratio of perimeter to area is then greater and the angular deflection sharper. It seems probable that there is an approximation to a jet action at low lifts, the discharge taking place at a region of relatively low pressure, somewhat after the manner of the true jet used for measurement at the outlet end of the cylinder. The comparatively high discharge efficiency of any such jet seems to make this the most probable explanation of the high coefficients.

If such jet action takes place, the pressure in the valve area should approximate that of the cylinder itself, and the theoretical velocity through the valve should be computed upon the lower pressure rather than the higher. This would reduce the error involved in computing the theoretical flow and coefficient upon the assumption of atmospheric density in the valve, as has been done.

Pressure Used in Tests

The maximum static pressure in the cylinder was 17.5 in. of water. As a pressure of 1 in. of water is equal to a pressure of 0.5768 ounce per sq. in., this would equal a pressure of 10.09 ounces, or 0.631 pound per sq. in., or an absolute pressure of 15.23 pounds per sq. in., 755 millimeters observed atmospheric pressure being equal to 14.60 pounds per sq. in. The density of the air varying with the absolute pressure and the ratio of absolute pressures being 1.046, the error involved under the above assumptions would be about 2.2 per cent as the density of the air enters the equation under the radical sign. This error would be materially less at the lower lifts, the pressures in the cylinder then being considerably less. No appreciable error would appear to be introduced by assuming equal temperature and equal humidity at valve and jet for any given valve opening and pressure drop.

Referring again to Fig. 4, it will be noted that, in lower chart, where the coefficients are compared at the same abso-

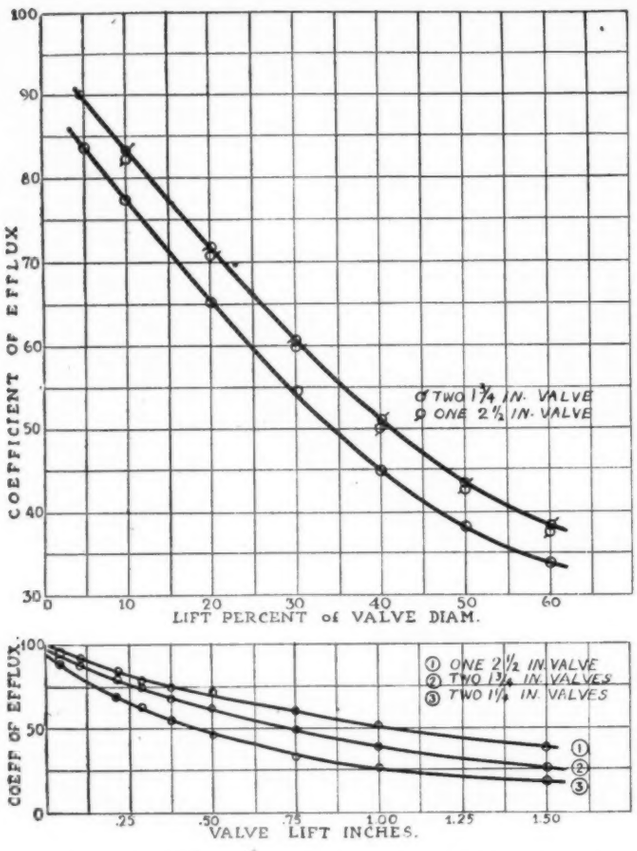


Fig. 4—Coefficient of efflux plotted against valve lift

lute lift, the differences between the three valve combinations are quite considerable, and that at the very low lifts the points plotted present some irregularities. The curves have been drawn to conform to the greatest number of points reasonably possible, and the curves in the upper chart have been plotted from those in the lower. The points for the two larger combinations so nearly coincide in the upper chart that but one line has been drawn.

The relative intercepts of the coefficient curves in the lower chart at various absolute lifts, expressed in per cent of the values for the single 2.5-in. valve, are presented in Table 1.

TABLE 1

	Relative coefficient of efflux.				
Valve lift in inches.....	0.125	0.25	0.375	0.50	0.625
2 valves, 1.75 inches diameter....	96%	94%	91%	89%	86%
1 valve, 2 5 inches diameter....	100%	100%	100%	100%	100%
2 valves, 1.25 inches diameter....	87%	79%	73%	69%	64%

In the upper chart it will be seen that when compared on a basis of equal valve lifts, expressed in per cent of diameter, the coefficients are much more nearly equal, the curves for the two larger combinations coinciding, and that for the small valves being but little lower. It seems entirely probable that even this small difference is largely caused by the converging lines of the passages leading to these small valves, as before explained. The comparative values are here shown.

TABLE 2

	Relative coefficient of efflux.				
Valve lift in per cent of diameter	0.10	0.15	0.20	0.25	0.30
2 valves, 1.75 inches diameter ..	100%	100%	100%	100%	100%
1 valve, 2.50 inches diameter....	100%	100%	100%	100%	100%
2 valves, 1.25 inches diameter....	93%	92%	91%	90%	90%

General Considerations

The only experimental investigation of the flow of air through poppet valves of which record was found in the technical publications was carried out as a thesis by R. M. Strong and F. W. Hollman, and later published by Prof. C. E. Lucke under the title "Pressure Drop Through Poppet Valves," Vol. 27, Transactions of the American Society of Mechanical Engineers (1905). Prof. Lucke seems to have been the first to call attention to two noteworthy characteristics, which are found to be supported by the data here presented; first, that the coefficient of efflux, computed for air at atmospheric density, is nearly constant for all pressure drops; and, second, that this coefficient is much larger for low lifts. Tests were made both with continuous flow and intermittent flow, the latter being as nearly as possible similar to actual operating conditions for the two gas engines tested, and it was found that the coefficient of efflux for continuous flow was not the same as that for intermittent flow, even at the point of zero acceleration.

It is patent that extreme care should be exercised in any attempt to apply the results of continuous-flow experiments to flow under operating or intermittent conditions, since inertia and resonance effects in the inlet manifold will obviously make great differences in the absolute quantities, and these effects will vary with the type of manifold used. Moreover, the pressure drop, velocity, and coefficient will obviously vary with many other factors as between different engines, different speeds for the same engine, and as to instantaneous values at different points of the stroke for a given engine at a given speed.

Question of One or Two Inlet Valves

However, in the question of design as to whether two inlet valves or one should be used, it is believed the comparative results here presented may be made to serve a real purpose. It is difficult to perceive any reason why the comparative relations obtaining between these three valve combinations for continuous flow should not find some parallel in the comparative relations between the same three combinations for intermittent flow, if no other variables are permitted to affect the comparative results in the latter case. Only inherent differences between the three combinations, effective with intermittent flow and noneffective with continuous flow, or vice versa, would appear capable of affecting this parallel, and it is improbable that such differences, if any, are of great magnitude.

The dimensions of the cylinder model used for these experiments offer a ready basis for discussion, and are commonly encountered in aviation engine practice, the bore being 5 in. and the diameter of combustion chamber 5.75 in. A combustion chamber of this size permits the use of two valves of 2.5 in. dia., or four valves of 1.875 in. dia., inclined at 15 or 20 degrees to the cylinder axis in both cases. Four 1.75-in. valves can be placed in a 5.5-in. cylinder head inclined, or a 5.75-in. cylinder head vertical; and four 1.5-in. valves are even more readily accommodated in a 5-in. cylinder head, or a cylinder having the combustion chamber the same diameter as the cylinder proper. These valves may be placed vertically, and the cylinder is much more easily machined. The combustion chamber will have better proportions, and the slight increase in cylinder height will be more than offset as to over-all height by the saving in spring length.

Advantages of Two Smaller Vales

Two 1.5-in. valves will have a flow capacity equal to one 2.5-in. valve at the same pressure drop and the same lift, will present but 72 per cent as much area to any pressure in the cylinder at the time of opening, and will weigh but 56 per cent of the weight of the single valve, assuming that the weights vary as $D^{2.5}$, which is approximately correct for these sizes. Assuming any reasonable pressure in the cylinder at the time of valve opening, and spring tensions in proportion to valve weights, it is evident that the two small valves will require less than half the power to open them, and this will be a direct saving of mechanical loss, as valve action is not the type of reciprocating motion which can return during one portion of the stroke energy stored during another portion, excepting only the energy stored in the spring.

It has been said that valves in pairs are more difficult to cool than single valves, but this does not appear to stand analysis. The proportion of the 5-in. cylinder head occupied by the small valves is only about 95 per cent of the proportion of the 5.75-in. head occupied by the large valve. The circumference of the two valves is 20 per cent greater than that of the single valve, and although the seats would have some-

what less width, the distance of heat flow in this direction would be but 60 per cent as great. As to the portion of the heat which flows to the guide, the conditions are also somewhat in favor of the small valves, the distance to the water-cooled portion of the guide being less and the proportion of water-cooled guide greater.

In one example of foreign engine design dual valves of about this size are lifted to one-half diameter, and give entirely satisfactory operation at speeds up to 2200 revolutions per minute. The possibilities in this direction are largely untried, but the negative work used in overcoming valve resistance to inlet flow might be reduced with small valves at high lifts and the volumetric efficiency increased, without introducing serious mechanical difficulties. This, of course, is contrary to the principle of using low lifts to secure a higher coefficient, but still the over-all result might be beneficial.

The comparison of a single 2.5-in. valve to a pair of 1.75-in. valves may be analyzed in much the same manner, and as to heat conditions the result would seem slightly in favor of the pair. If lifted 0.375 in., the capacity will be 25 per cent greater than that of one 2.5-in. valve, according to the experimental results, or the resistance will be but 64 per cent as great, the resistance varying approximately with the square of velocity or capacity. This should result in higher volumetric efficiency. The superficial area of the two combinations would be practically equal, but the weight of the pair would be but 82 per cent of that of the single valve, with correspondingly reduced total spring tension and slightly reduced mechanical loss.

Comparison With Mercedes and Benz Results

Interesting comparisons may be drawn from data published by the *Automobile Engineer*, London, Vol. VII, Nos. 105-6-8-9 (1917), covering Benz and Mercedes engines, each make being constructed in both 2-valve and 4-valve models. Except for the valve changes and an increase in compression ratio from 4.50 to about 4.90, the design of the 4-valve models is much the same as that of the respective 2-valve types. The data are represented in Table 3, the ratio of volume to horsepower and brake mean pressure being given for the rated power at 1400 revolutions per minute for each engine. The "valve-factor" is one-half the product of inlet-valve opening area by the number of degrees open divided by the displacement of one piston, affording a ready index of relative valve capacity.

TABLE 3

Engine	Benz 4-valve	Mercedes 4-valve	Benz 2-valve	Mercedes 2-valve
Bore, inches	5.71	6.30	5.12	5.51
Stroke, inches	7.48	7.09	7.09	6.30
Piston displacement per cylinder, cubic inches	191.38	220.82	146.05	150.20
Piston displacement, total cubic inches	1,148.30	1,324.90	876.30	901.20
Valve port diameter, inches	2.04	2.17	2.42	2.67
Valve lift, inches	.465	.398	.433	.440
Inlet valve opening, square in.	2.99	2.72	3.29	3.70
Rated horsepower	230	260	160	160
Rated revolutions per minute	1,400	1,400	1,400	1,400
Maximum horsepower	250	270	164	162.5
Maximum revolutions per min.	1,650	1,650	1,400	1,400
Inlet-valve opening, degrees	245	228.3	2.40	213
Area inlet pipe, square inches.	3.65	6.85	2.96	3.54
Cubic inches piston displacement per horsepower	4.99	5.10	5.48	5.63
Compression, ratio	4.91	4.94	4 50	4.50
Valve factor	3.80	2.82	2.70	2.62
Brake, mean effective pressure	113	107.5	103	102

The valve factor for the 4-valve Mercedes is but slightly larger than that of the 2-valve, and the mean effective pressure is increased only 5 per cent, which is practically accounted for by the increase in compression ratio from 4.50 to 4.94. In the Benz 4-valve, the factor is increased 35 per cent and the mean effective pressure increased 10 per cent, only about one-half of which can be due to the increase in compression ratio from 4.50 to 4.91.

In Fig. 5 a comparison is made of the power output of these four engines plotted against gas velocity through the inlet valve. These velocities are computed for this comparative purpose as the ratio of piston displacement per explosion to one-half of the product of valve-opening area by the time of the opening. The broken curves represent the 4-valve Benz and Mercedes, respectively, reduced approximatly to compensate for difference in compression ratio.

In conclusion, a summary of the results experimentally derived is presented. It should be borne in mind that the number and character of the experiments is not such as to render them final and conclusive.

Conclusions

1. The coefficient of efflux is practically constant, for all pressure drops (at least below 1 pound per square inch) where the lower pressure is approximately atmospheric, and the theoretical flow is computed upon air at atmospheric density.

2. Under conditions of general similarity, the coefficient of efflux is very nearly the same for valves of different sizes, at equal lifts expressed in per cent of their respective diameters.

3. Lifting a valve one-quarter of its diameter may develop an area of opening geometrically equal to its port area, but affords a capacity less than 67 per cent of that of the unobstructed port, at the same pressure drop; a lift equal to one-half diameter develops 80 to 90 per cent of this maximum capacity.

4. At the same pressure drop, one valve of diameter D and lift h is equal in capacity to:

First, a pair of valves of diameter 0.707 D (equal port area) and lift 0.707 h.

Second, a pair of valves of diameter 0.6 D and lift h, for values of h not exceeding about 0.25 D.

—

REGARDING the relative merits of case-hardening and oil-hardening compositions, in certain kinds of service case-hardened gears are undoubtedly superior, while in others oil-hardened are best. As a general rule, the oil-hardened gear can be counted on for steady, uniform wear. Where a case-hardened gear is used the wearing down of the case to the core at any point means that the gear is gone. Similarly, if the case cracks it will flake, and the gear is gone. The actual cost of case-hardening will usually run slightly greater than that of oil-hardening. Oil-hardened gears always give a lower scleroscope hardness than case-hardened gears, but this is not a criterion of wearing quality, as the toughness of the material always enters in.

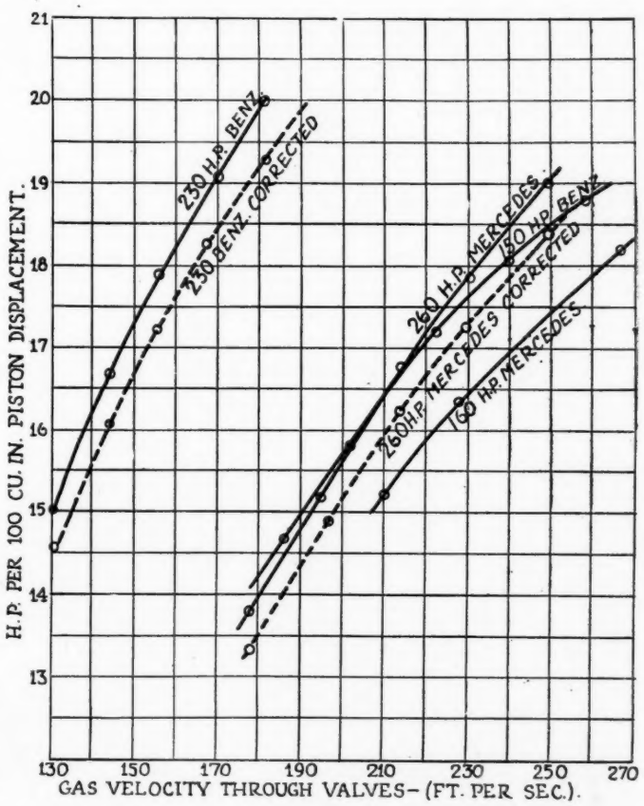
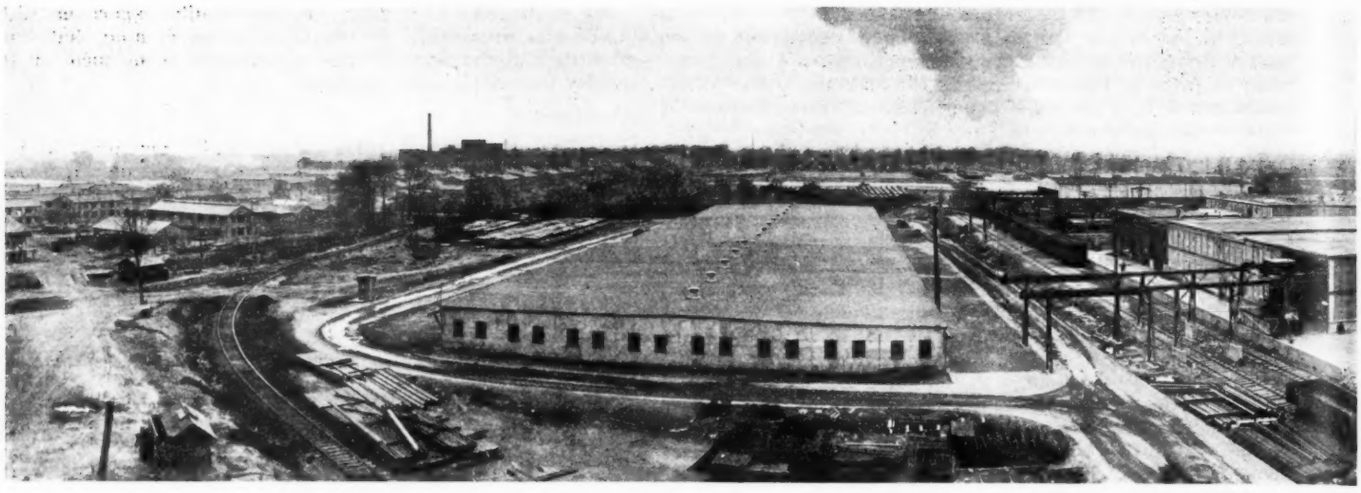


Fig. 5—Specific power output as dependent upon gas velocity through valves



Shows the mechanical repairshop at the left, storage

Camp Holabird—Largest Truck Overhaul Depot

Present Capacity for Assembling 30 Trucks a Day and Crating 22 an Hour for Shipment—1400 Trucks a Month Overhauled, Crated and Shipped

BALTIMORE, MD., Dec. 16—One hundred and fifty acres of uncultivated land converted into a beehive of industry; a motor truck overhaul plant of 200,000 sq. ft., capable of fully assembling 30 motor trucks per day; a packing plant 800 by 200 ft. with a capacity for completely crating 22 trucks per hour; a storage and shipping department with a capacity for handling 2200 tons of spare parts monthly—in brief, a complete organization of 7000 men and a factory which with a slight expenditure could be the equal of many truck producing plants—this is Camp Holabird, the largest motor truck overhaul depot in the world, and erected within the last 10 months at this city.

The illustrations on this page show the best indication of the remarkable development of this camp in less than a year. A description which appeared in these columns 8 months ago told of the beginning of activities and showed illustrations of the grounds and the laying of foundations for some of the buildings. At that time the camp housed less than 500 men.

To-day it has an organization of 7000 men.

It has cleared as many as 1400 trucks a month, overhauled, crated and shipped them.

It has trained as many as 4000 motor mechanics within a month and shipped them abroad to the American Expeditionary Forces.

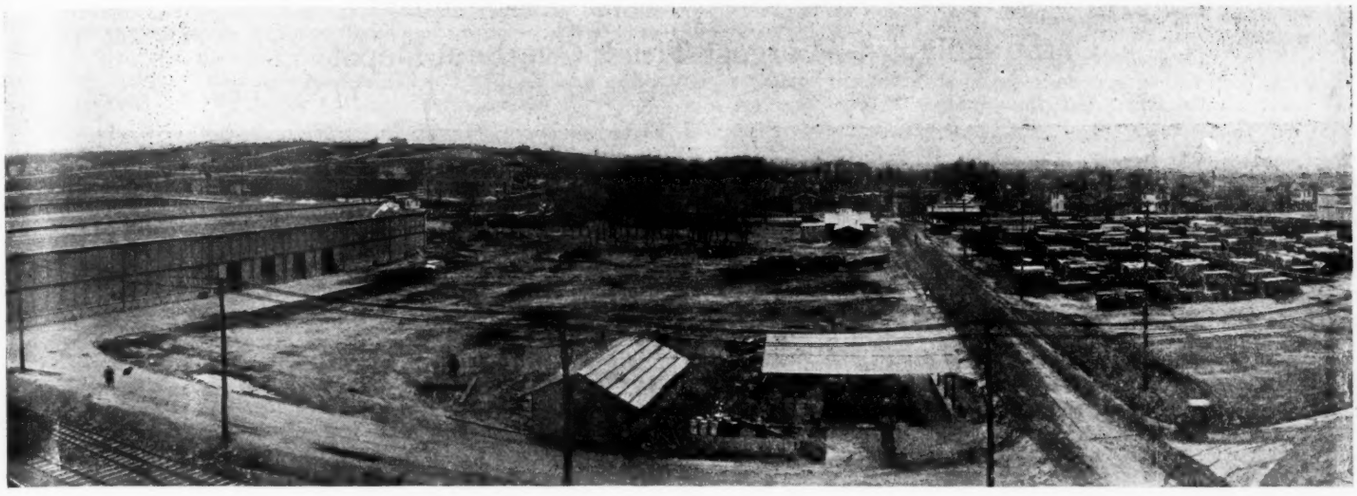
It has had as many as 7000 trucks in storage at one time.

It has completely torn down and overhauled and assembled 48 trucks in a day.

It has shipped 2200 tons of spare parts in a month.

It has disassembled and completely crated and shipped 115 trucks in a day.

Shows the crating shop in the center, with the electrical crane which loads directly to the freight



house in the center and trucks to the right

Occupying land to the northeast of Baltimore, the camp is to-day a mass of machine shops, tents, barracks and warehouses. The overhaul shop, 497 by 480 ft., one story high, comprises 28 departments, including chassis bays where the trucks are torn down, where the engines are completely inspected and repaired, and the final test room, where the trucks are reassembled and inspected, following which they are given a 50-mile road test and sent to the reserve park. In addition there are complete welding, drilling, painting, wood working, tire repair and other departments.

Painting is done by a spraying process which takes 15 minutes per truck. The shop has a stall capacity for 120 complete overhaul jobs at once.

A part of this space is assigned to passenger cars and a part to trucks. Motorcycles also have their respective space. On arrival at the shops, a vehicle is carefully inspected by an officer, who determines what the nature of the repairs to be done will be. The truck is then ticketed and sent in to be washed and then assigned to its stall.

A crew of men disassemble the truck; in the case of the complete overhaul the mechanism is taken to pieces until nothing remains but the bare frame. The various brackets and fastenings of the frame are inspected, loose rivets cut out and re-driven to make them absolutely solid and tight once more, and the process of reassembly is then ready to begin.

Meanwhile the units as fast as removed from the truck were ticketed with truck number and sent to the respective bays in the great shop where such units are handled.

The engine, for instance, goes to a special disassembling shop, and is given a bath in hot soda to cut the oil and grease from it, and is then rapidly taken to pieces, and passes before skilled inspectors, who examine the condition of each piece and card it with the work to be done.

These pieces then pass to machines whose sole function is to perform the one operation required—crankshaft grinders for the shaft grinding, cylinders for re-boring cylinders, piston grinders for handiing pistons. On completion of the work according to ticket, the parts once more pass over the inspecting benches, where the quality of the work done is carefully inspected and verified, and if need be, sent back for readjustment.

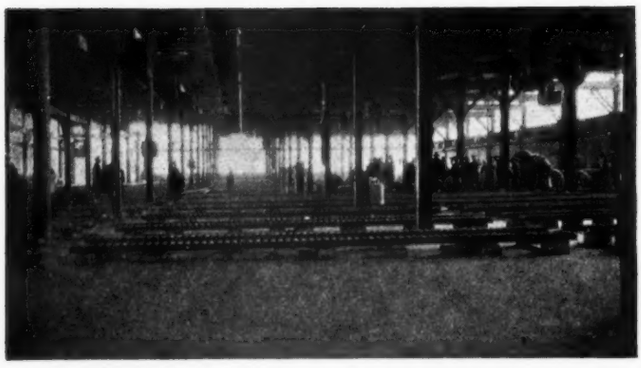
If acceptable, they pass to the reassembly bench just beyond. Thus in a few hours' time every part of the engine which is subject to wear receives mechanical treatment which brings it into as perfect condition as when originally manufactured.

The original makers employ the same tools that are used in this army shop for repairing and refinishing. When the engine has been reassembled, it is put on the stand and driven by belt power for some hours to smooth the bearings and make the working parts run quietly. It is then removed to a testing stand, where it is given gas and run under its own power against a dynamometer, and is not released from this stand until it generates the required amount of power for an engine of its class.

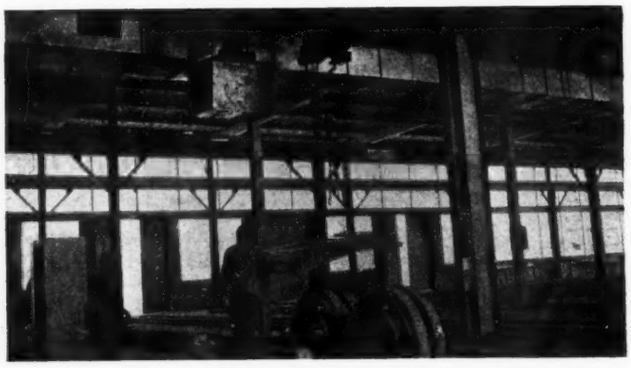
There is no guesswork about this part of the job. Every engine must deliver its quota and run absolutely sweet and true before release. While this work is being done on the engine, the transmission is also receiving similar treatment

cars, and one of the warehouses to the left of it. A group of motor trucks can be seen at the right

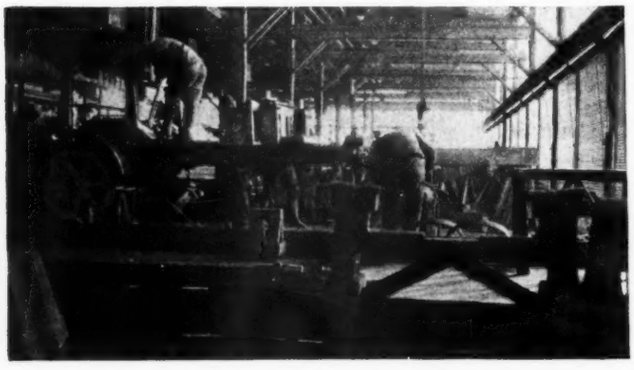
Camp Holabird—Largest Truck Overhaul Depot



The crating room with 22 roller ways and a capacity for tearing down, crating and shipping a truck per way in 1 hour and 35 minutes

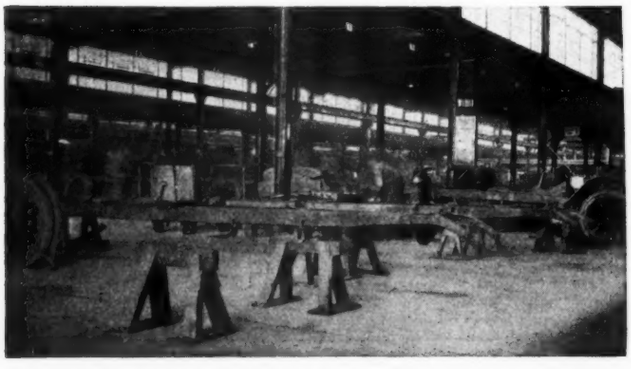


Showing the individual electric traveling crane used at each way. The crane in the illustration is lowering the floor of the crate, which is so arranged that almost all of the parts taken off the truck fit conveniently and compactly



Beginning the work of disassembling the truck. Showing the individual roller doors at the side of the building and leading individually to the disassembling stalls. The floor of the crate with many units distributed over it. Each unit is painted with oil, either by spray or brush, to insure against rust, which is often caused by the ocean atmosphere

View of many parts properly placed on the floor of the crate, and the frame and engine being lowered by the crane. The wheels are laid over the frame and the sides and tops of the crate are placed in position and securely fastened and the crate is then ready for shipment overseas



The chassis bays in the overhaul building where trucks in service on this side and intended for service overseas are disassembled and overhauled when necessary

Showing a part of the cantonment, a field, the band stand and the auditorium in which enlisted men are given instructions and special motor mechanics trained, and also serves entertainment purposes

in a separate bay; the axles and differentials are receiving treatment in an adjacent bay; and every minor part of the vehicle—magneto, carbureter, radiator, steering gear, even the siren—is repaired by men who do nothing else, and know the last word in tuning up their respective units.

In due course of time the units travel, by a telpher or overhead crane, to the bay where the original frame stands, repaired and ready to receive them. In the case of standardized vehicles, every unit drops into its place without interference or loss of time. Where a conglomerate mass of different types of vehicles is to be repaired, there is naturally a tremendous slow-down in the rate of repair.

The amount of time required to take a truck to pieces completely and reassemble it, substituting already repaired units in case some particular part of the truck would otherwise delay re-erection, is approximately 4 working days.

Thus, with 120 stalls fully occupied, there should come out of the factory at least 30 completely rebuilt jobs daily, working one shift. Where the kind of repairs is less serious than completely rebuilding, the number would be proportionately increased. In ordinary work the shop would normally probably handle 50 or 60 jobs per day, but under pressure and with double shifts the number could be increased to 100 jobs, of which about 50 would be complete overhauls.

Thus it is seen that this shop is really a tremendous manufacturing institution, a specialized factory devoted to doing that kind of repairing which the operation of a large fleet of motor vehicles requires. The experiences of Mexico and France have taught the Army that maintenance is the key to success. A truck literally eats parts, as a mule eats hay and oats.

The personnel of the shop required is 55 officers and 1402 men. As a matter of practice the personnel may be more numerous, as it has been necessary to have a considerable number of men in training.

The warehouse buildings, 800 by 200 ft., like the other factory structures, are composed of steel, glass and concrete. The buildings are divided into sections, one section containing those spare parts for domestic use and the other those for overseas duty.

Crate 22 Trucks an Hour

The most remarkable feature of the plant is the crating department, including complete carpenter shops which manufacture the crates from raw lumber materials, making them in six pieces. A huge electrical traveling crane picks up the floor of the crate and deposits it on one of the 22 roller ways in the crating room, which is 800 by 200 ft.

This room is so constructed that it contains 22 ways for 22 trucks which enter through individual rolling doors along one wall on their own power, standing before the way along the wall. Two other electric cranes operate in addition to the crane that carries in the crate.

As quickly as the truck is run through the door and before its way the crew of mechanics start their work of disassembling and laying the parts in their proper position on the floor of the crate, which is conveniently arranged on the roller ways directly in front of the truck.

The body is loosened, lifted and whirled away to a distant corner of the shop by a crane, where it is torn down and crated in a flat package. An electrical traveling crane is operated above each way and picks off the heavier pieces of the truck and deposits them on the crate floor. The truck is completely disassembled until nothing is left but the frame containing the engine, and all of the parts are so conveniently distributed over the floor of the crate that the frame and engine can be laid on top compactly, and over them are placed the wheels. When the truck is completely disassembled and crated a third crane picks it up and carries it to the far end of the building through a huge door and into the waiting freight cars. The complete operation of running in a truck, disassembling, crating and loading occupies 1 hour and 35 minutes.

Crating Time Cut Three-Fourths

The truck completely crated consumes 370 cu. ft. of space. It is said that the crating operation is done in one-fourth of the time formerly used by motor truck makers, and that the crate, which is 18 ft. long, 40 in. high and 40 in. wide, is one-fourth as large as the motor truck crates used by the manufacturers, and which occupy 1200 cu. ft.

All of the automobile truck and passenger car makers, it was stated, are sending their representatives to learn this crating method. Prior to closing the crate, all parts are painted with a solution of vaseline and lubricating oil, part of this operation being performed by a spray and the remainder with pail and brush.

The carpenter shop has turned out an average of more than 100 crates daily. It can manufacture many more than this, but is limited by the consumption of the crating room. The crate shop is an absolutely unique institution and cost $500,000. It was so designed that following the war, when crating is no longer necessary, the building and machinery can be used for body building and body repairing, and it will use the complete camp outfit, making one repair shop for repair and construction of chassis and the other for construction and repair of wooden bodies.

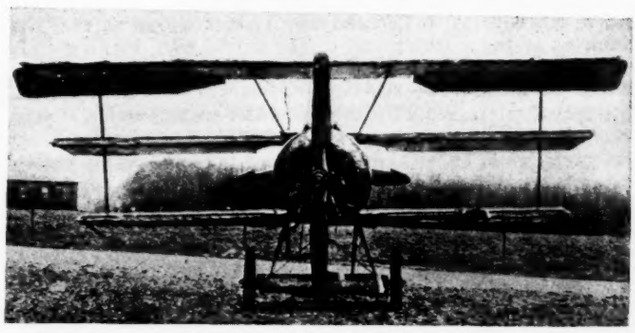
Camp Holabird, which is exclusively a motor transport base, will be the distributing point of motor trucks for the United States Army for all territories. It is planned as a permanent institution. It is responsible for the maintenance and repair of all Army motor vehicles in the United States, which include 40,000 trucks, 10,000 passenger cars, 15,000 motorcycles and bicycles and 6000 ambulances. All heavy repairs, reconstruction and salvage are taken care of by the repair shop unit. Only minor repairs are made by local repair shops or commercial garages. The motor trucks are sent to the overhaul shop only when major repairs are to be made, which local service stations are unable to handle. About 40 per cent of the vehicles coming to the shop require rebuilding.

The need for so complicated a repair and construction institution as Camp Holabird was caused by the use of more than 100 types of vehicles by the American Expeditionary Forces.

Besides the mechanical work, Camp Holabird is also a very large center for motor transport activities. It is the headquarters for the district motor transport officer who administers the entire northeastern district of the county. It is an organization park at which motor transport personnel is received, organized, trained and equipped. It is a supply depot for motor transportation. It is expected that the camp will continue during peace times in the training of men for motor transport, and it will serve in the future as a necessary storehouse for motor repair parts and supplies for the Army in times of peace. Its fireproof warehouses are capable of storing millions of dollars' worth of parts and tools.

The camp has not neglected the social aspect. It has 7000 soldiers housed in cantonments which constitute a veritable city, and which has been supplied with pure water, sewerage, electric lights, streets, sidewalks, hospitals, bakeries, kitchens, bathing facilities, and lastly a huge auditorium where the men are entertained and instructed. There are also ball grounds, recreation grounds and the Y. M. C. A. hut. The camp has a band of 40 pieces which leads the men to their meals and also affords considerable entertainment in hours of relaxation.

Fokker Triplane



This is the type of machine flown by the late Captain von Richthofen

The Use of Measuring Wires

Permits of Accurately Determining the Effective Diameter of Screw Threads—Much Used in Inspecting Plug Thread Gages—Precautions Necessary in the Use of the Wires

FOR some time extensive use has been made of measuring wires for making accurate measurements of the effective diameters of screw threads, and wires for this purpose, which necessarily must be very accurate in dimensions and straight, are now on the market. The effective diameter of a screw thread is the length of a line through and perpendicular to the screw axis measured between the points where the line cuts the slopes of the thread. The method of thus measuring the diameter and the principles involved were discussed in an A. S. M. E. paper by H. L. Van Keuren of the Bureau of Standards.

In measuring screws by the three-wire method, cylinders accurately ground and lapped to size and diameter are used. These wires or cylinders are inserted in the thread two on one side and one on the other. A measurement is then made directly over the tops of the wires by means of an outside micrometer or other suitable measuring device. From this measurement and from the size of the wire the effective diameter of the screw can be computed.

Choice of Wires

In the choice of wires any size may be selected which will permit the wires to rest on the flanks of the thread and still project above the top of the thread. It is best, however, to choose wires of such a size that they touch the sides of the thread half-way down, or, in other words, at the mid-slope. In this case errors in the included angle of the thread have no effect on the measurement of an effective diameter. Moreover, the time spent in computations is greatly reduced. The best sizes of wire for varions threads may be computed from the following approximate formula:

$$G = \frac{P}{2} \sec a$$

where G = diameter of wire, in.
P = pitch in in.
a = ½ included thread angle, deg.

For 60-deg. threads this formula reduces to

$$G = 0.5774 \times P$$

The following extracts are taken from specifications recently written by the Bureau of Standards for purchasing wires for measuring thread gages: "The wires used are to be of steel. The working surfaces are to be glass-hard and lapped to a high polish. The working surface should be about one inch in length and the wire should be provided with a suitable handle. The handle should be provided at one end with an eye or hole for the purpose of suspending the wire when measurements are taken. On one side of the handle, which is flattened, there should be marked the pitch for which the wire is to be used as the best-size wire and the diameter of the working end of the wire. The working ends of the wires should be round to within 0.00002 in. and they should be straight to 0.00002 in. over any ¼-in. interval. One set of wires should consist of three wires, which should be of the same diameter to within 0.00005 in. This common diameter should be within 0.0001 in. of the size corresponding to the best-size wire for the pitch with which the wire is to be used."

Standardization of Wires

Before the wires can be used to measure effective diameters of threads it is necessary to know accurately their diameters. The wires should be standardized in a way which approximates, as nearly as possible, the conditions under which they are used. In order to accomplish this purpose the wires are standardized with a micrometer caliper by measuring the wire when placed over a standard reference disk, the diameter of which is accurately known. The object of measuring the wire over a cylinder is to approximate the condition of pressure which is exerted upon the wire when it is placed in the screw thread. The micrometer to be used for this purpose should be one which has graduations to ten-thousandths of an inch and upon which hundred-thousandths of an inch can be estimated. This can be secured in one of the similar forms of small precision bench micrometers. Care should be taken to make sure that the micrometer measuring faces are sufficiently parallel. If the wires differ appreciably in diameter, the two having diameters most nearly equal should be used on one side of the thread and the other wire should be used on the opposite side. In the computations the mean diameters of the three wires may then be safely used.

Computation of Effective Diameter

In the computation of the effective diameters of thread gages, if the exact conditions are recognized the formula is quite complicated and the resulting computations are very laborious. The formulæ for computing effective diameters as given in most engineering handbooks involve the use of best-size wire and do not take into account the complications introduced when considering the effects of the helix angle of the thread. These formulæ, as generally given, result in securing an answer which should check with the outside or full diameter of the screw being measured. The effective diameter is not mentioned in these formulæ and this often leads to confusion. Reference will therefore be made here to a simplified formula for 60-deg. threads which results in the direct computation of the effective diameter. This formula is as follows:

$$E = M + \frac{0.8660}{N} - 3\,G$$

where E = effective diameter
M = measurement over the wires
N = number of threads per inch
G = diameter of wires.

In the use of this formula the term $0.8660/N$ may be computed for various pitches and the computations simplified.

The general formula which may be used for any size of wire which will fit in the thread and which takes into account the helix angle of the thread for precision measurements is as follows:

$$E = M + \frac{\cot a}{2N} - G\,(1 + \sqrt{\operatorname{cosec}^2 a + s^2 \cot a})$$

where a = ½ the included angle of thread
G = diameter of the wires
s = tangent of the helix angle.

The above formula involves squares and a square root of functions and therefore is awkward for making computations, and the following formula, which is an expanded approximation but which is accurate to better than one hundred-thousandths of an inch, is more convenient:

$$E = M + \frac{\cot a}{2N} - G\,(1 + \operatorname{cosec} a + \frac{s^2}{2} \cos a \cot a)$$

This formula is a general approximation which may be used for U. S. form 60-deg. threads, Whitworth 55-deg. threads, Lowenhertz 53-deg. 8-min. threads, and for other threads of a similar nature. It should be noted that the error due to

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"The Automobile After the War"

Views and Suggestions of Georges Cote to Automobile Manufacturers of France as to Means and Methods of Meeting Reconstruction Problems and Foreign Competition

Reviewed by N. S. Diamant, Harrison Radiator Corporation, Lockport, N. Y.

THE vital and all important problems of reconstruction have received the attention of engineers and industrial leaders in spite of the great and pressing needs of the war. Thus Georges Cote, director general of the Pilain Automobile Company of Lyons and Paris, in a book* bearing the above title considers the problems of reconstruction and those having to do with successful competition by French automobile manufacturers with foreign makers.

In an introductory way attention is first called by Mr. Cote to the situation that will arise immediately after the declaration of peace; although the market will be flooded to a certain extent with military cars, the unfavorable reaction of this on the market condition will probably be limited, and, in any case, the situation will have to be met once only.

The real danger he considers to be the growth of American competition, which is already fairly large. Since 1913 the American danger began to be felt, and energetic measures of protection were requested by French manufacturers, in view of the obvious inclination of the public to become converted to American ideas, although the majority continued to patronize the sporty and aesthetic French cars. However, the war, with its great demands on equipment and production, made necessary the purchase and introduction of immense quantities of American products, and the public thus had occasion to appreciate American designs which for so long had been adversely criticised. The public judged them from a utilitarian point of view.

War Has Popularized the Automobile

The transportation facilities that will be required in the invaded territories which have so savagely been ruined, and in the French colonies, can be met only by the assistance of the automobile and the truck. Particularly, when it is remembered that the rolling stock of the railroads has deteriorated so much in meeting war conditions. Finally, the war seems to have popularized the automobile so much that we can say the latter has become part of our life and customs.

Thus the manufacturers of France should not count so much on "universal reputation" to produce the best quality car as they have done in the past, but rather give to the purchaser a reasonable-priced, useful car.

According to Mr. Cote, the "dominant characteristics" of the utility car are the following: 1. It must be easy to drive and relatively free from deterioration of the most important parts even in the hands of the inexperienced driver. 2. Its operating cost must be low. 3. It must be capable of use even on very bad roads. 4. The price of the car must be as low as possible.

The author calls attention to the dominant characteristics which made the success of the Ford car possible, and thinks that these are its ease of control and minimum deterioration of the engine even in the hands of an inexperienced driver. In this connection he thinks that the present day common method of speed changing is one of the glaring defects of cars, inasmuch as it involves a rather skillful combination and manipulation of a hand lever with a pedal. Unless this is properly done the machine suffers considerably and some of the most essential parts rapidly deteriorate. With reference to the above, the question of two or three speeds is raised, and the opinion expressed that unless the car is light in weight and the engine fairly powerful, which is the case with the Ford, two speeds can hardly be considered sufficient.

Two Devices for Changing Speed

In this connection Mr. Cote briefly describes two patented devices for changing speed, one of which is electromagnetic, and he calls special attention to the great desirability of using the engine itself not only for propelling purposes, but for braking as well. He calls attention to what he considers the most wonderful experience he has had with the above electromagnetic system, with which, while a car was going down hill, the control lever was placed on "reverse" and without the use of brakes at all the car was slowly stopped and reversed without the least shock or jar. Mr. Cote simply gives these general ideas and leaves it to the specialists to go into these matters deeply and carefully.

The author emphasizes the importance of a "flexible" car and cites American practice as a fine example, which French manufacturers could well afford to follow, and if necessary pay less attention to the question of efficiency, which is considered so important on account of the high cost of gasoline in France.

Attention is called to the two-cycle engine, and the question is raised whether it may not be possible to improve its efficiency. Considering the susceptibility of this engine to great simplification and cheap construction, it is desirable to undertake research along this line.

Front Axle Drive

Another idea emphasized by the author is that of front drive, which is very desirable for light-weight cars. The front drive is very rational and simplifies greatly the mechanical arrangement of the chassis. This arrangement makes possible better distribution of weight, allowing the front axle to carry more dead weight and relieve the rear axle, which carries most of the useful weight. Front drive also makes possible the advantage of front braking, which is preferable since the front wheels have a greater coefficient of adhesion. Finally, one might add the advantage of having a closed, quiet car with the passengers in the rear and the engine with its accessories in front.

*"The Automobile After the War," by Georges Cote, Director General of the Société des Automobiles Pilain (Lyons-Paris), 125 pp. published and copyrighted by H. Dunod & E. Pinat, 47 Quai des Grands-Augustins, Paris, 1918.

The author continues and calls attention to the desirability of increasing the distance between the ground and the chassis and of the judicial reduction of weight, and he believes that an ordinary four passenger automobile should not weigh more than 1300 to 1600 pounds (or 600 to 700 kilograms).

Production

The author in this connection calls attention to the handicap of the manufacturers who had to follow "the whims of fashion." He thinks it would be very much better if a given company after incorporating all the qualities which answer the real needs of the majority of its customers would be able to put its production on an all the year round basis, and thus increase and facilitate its output greatly.

Standardization

On the basis of past experience he advocates the classification and standardization of self-propelled vehicles and suggests the following:

Class 1. "Popular Car" selling at lowest possible price, and corresponding to the "Ford."
Class 2. Semi luxe, which would correspond to the present day 12-hp. (French) cars.
Class 3. The car "de luxe," which should be built in three types, namely, for city, tourist and sport purposes.
Class 4. A small rapid delivery truck good for useful loads of about 2600 pounds or 1200 kilos.
Class 5. A heavy truck which can be built in capacities of two and four metric tons (4400-8800 pounds).

Standardization of this kind would benefit the industry enormously.

Possible Forms of Co-operation

Mr. Cote suggests and advises forms of co-operation between different manufacturers, by either organizing a syndicate or merging a number of firms. He suggests that the different firms in the industry decide to specialize in one of the classifications already given and form a strong association, the returns of each being made proportional to the capital invested. He favors an independent association, and not the absorption of smaller companies by larger ones.

The second form suggested is that of a "syndicate," among the advantages of which would be the distribution from a central organization of all the raw materials and tools which are to be used by the different members. This would result in considerable economy. Furthermore, besides a central purchasing office the syndicate might have some kind of a central office for inventions to which all inventors could submit any designs and plans of interest to the automobile industry. A special organization of this kind would greatly facilitate the testing of new schemes, and demonstrate their practical feasibility. The author thinks a "syndicate" would present all the advantages of "combination," conserving at the same time the independence of each member, whereas "fusion and merging," if generalized might pave the way to a "trust," and thus would become incompatible with democratic and individualistic ideas.

Labor

Under this heading the author calls attention to the generalization of labor saving devices and the increasing substitution of machines for men. In this connection he approves and speaks highly of American methods of specialization and selection.

The following interesting figures are given to show the great possibilities of expansion of the automobile trade in France and its colonies. The increase of automobiles, including trucks, in France was as follows:

7,183 vehicles from 1908 to 1909
8,900 vehicles from 1909 to 1910
10,540 vehicles from 1910 to 1911
12,562 vehicles from 1911 to 1912

In 1914 the total number of automobiles, including 6000 trucks, was about 100,000 and during the war there have been added 35,000 trucks and 10,000 small trucks, making a total of 145,000 for a population of 39,000,600; that is, one automobile for every 273 people. Without suggesting the possibility of equalling the figure reached in the United States, which according to 1916 statistics is one automobile for every 29 people, it would seem that there are great possibilities of increasing the number of automobiles in France. Further, considering the whole of Europe in order that it may have the same ratio of automobiles to population as that of the United States, the total number of automobiles of all types should be 15,583,000, instead of 437,600, representing an increase by 15,145,400. Going a step further and considering Africa, Asia and Australia, it will be found that on the same basis the total number of vehicles ought to be 56,000,000 instead of 4,500,000.

It is idle to base any economic studies on the latter figures, since it will not be possible for the world and even for Europe to have the same proportion of cars to population as America. However, the above figures do show that there is a great field which justifies the making of a special definite effort to increase the production. The logical consequence of increased production will be a complete revision of present commercial methods.

Actual Sales Methods

According to these the buyer gave his orders at not particularly attractive prices either to an agent or directly to the manufacturer, who in general could not fill this order immediately, but placed him on an indefinite waiting list. It was only the large companies which had "direct representatives" and service stations that could properly look after their customers. In short, the old methods did not offer any facilities to the buyer. The prices were rather high; also many cars were sold to men who owned one, and thus the manufacturers or agents had to take an old car back at their own risk. Further, the purchaser, being also a seller, became more exacting and hard to please. Thus the chief problem is to force automobiles among new buyers. To accomplish this two things are necessary—a reduction in price of all kinds of cars except the strictly de luxe type, and the provision of every possible service facility to the purchaser.

Price Reduction

Reference to this matter has been made before and considerable emphasis laid upon it. According to Mr. Cote, the selling price should differ as little as possible from the actual cost of production. The difference between these two items represents general sales expenses, agent's commission and the net profit of the manufacturer. The numerous facilities that ought to be given to the customer should be charged to the general item of sales and be given considerable importance; this situation should be accepted with all its consequences, and it will be found very profitable both to the manufacturer and to the agent.

Facilities to Be Offered to the Purchaser

According to the above the commission will represent a fair profit and the cost of efforts to attract prospective buyers and retain them. This can be done by means of

(*Continued on page* 1075)

Cultivating Japanese Automotive Field

PART V

Domestic Manufacture of Tires—Opportunities for American Tire Makers—Accessory Market Is Limited—Suggestions to American Manufacturers—Conditions Not Favorable to Tractors

By Tom O. Jones*

AT the present time there is no established preference respecting tire types in Japan. American cars imported are adapted to both clincher and straight-side construction. Since two of the largest American tire companies are now represented in the country, one by a branch house and the other by a distributer, practically any size tire can be secured in either hard or soft bead.

The bulk of the replacement business in Japan falls to the Dunlop Co. This is a separate corporation with both British and Japanese capital interested, but is allied with the British company of the same name. A large factory is maintained at Kobe, where the production is confined entirely to soft-bead tires.

This factory, which has been in operation for several years, manufactures not only tires but many other lines of rubber goods. Its business is not limited to Japan, but extends to various parts of the Far East, practically all the eastern business of the British parent company being turned over to the Japanese factory, so that its trade reaches as far south as Singapore. The factory is well equipped and according to the management, the workers are easily trained and soon become highly proficient in the work. Social work is carried on for the employees, with separate departments for men and women, in which there are lunch rooms, libraries, and games.

In value, the tire business done for jinrikishas exceeds that for motor cars. This can readily be understood when one considers the great number of jinrikishas that are used, not only in Japan and China but also in the Straits Settlements, and practically all of these jinrikishas are equipped with pneumatic tires.

Within the past year one of the largest American rubber companies has completed a plan of organization whereby it will operate a factory in Japan. A foreign organization entering the Japanese field will be materially assisted by having Japanese capital interested, and this is the plan adopted by the first American company to enter rubber manufacture in the Empire, a close alliance having been established with a large manufacturing concern. In the beginning practically all the manufacture will be mechanical rubber goods. When the plan was consummated last fall it was hardly expected that manufacture of tires could be undertaken in less than four or five years.

There are several Japanese rubber companies that import raw material from the rubber plantations of Malasia. In fact, Japanese capital controls a number of large plantations. But these companies all operate on a small scale, and for the present at least will have very little influence on the volume of American trade.

THERE is a big demand for jinrikisha tires, not only in Japan but also in China and the Straits Settlements.

American tire manufacturers should transact business through one house, unless they are disposed to open offices and send representatives. The latter proposition is not recommended.

There is an exceedingly limited demand for accessories, but it is suggested that a market may be found for glare-reducing headlight lenses.

The American manufacturer should be careful to avoid scaring the Japanese dealer or prospective distributer by demanding too much business for the first year.

Selling Agencies for Tires

It is advisable for an American tire company entering this field to do business through one house, unless the company feels disposed to open its own offices and send its own representative to the field. This latter proposition doubtless would have small appeal, because of the expense involved in conducting the organization and introducing the lines for the very small volume of business which can be expected when the company is only to get its share of the tire sales for less than 3000 automobiles. Japanese dealers handling tires are accustomed to the British plan of operation, that is, paying for the tires as they are sold and having the stock kept up by the tire companies.

Below is a table of prices prevailing in Japan last fall for one of the standard American tires, the quotations being for clincher-type fabric casings and tubes (yen=$0.498):

Size in Inches	Smooth or Nonskid. Yen	Tube. Yen	Size in Inches	Smooth or Nonskid. Yen	Tube. Yer.
30 by 3.....	47.50	12.20	35 by 4.....	91.00	18.50
30 by 3½.....	63.20	14.20	36 by 4.....	94.00	18.75
31 by 3½.....	65.50	15.10	33 by 4½.....	112 00	20.45
32 by 3½.....	68.00	15.30	34 by 4½.....	115.00	21.30
34 by 3½.....	72.00	16.20	35 by 4½.....	118.00	22.20
31 by 4.....	80.50	16.75	36 by 4½.....	122.00	23.00
33 by 4.....	86 00	17 60	34 by 5.....	140 00	27.00
34 by 4.....	89.00	17.90	35 by 5.....	146 00	28.00

*EDITOR'S NOTE—*Mr. Jones was formerly with the J. B. Crockett Co., New York, and was given a special appointment by the Bureau of Foreign and Domestic Commerce to investigate automotive conditions in Japan, China, the Philippines and Hawaii. This story is taken from the advance proof sheets of Mr. Jones' report to his department.*

The market for additional equipment or attachments for cars shipped from America is a small one. As a general rule, the Japanese buyer is disposed to take the car as it comes without extra equipment. Americans in the automobile business generally agree that the fewer equipment features the more disposed the Japanese are to favorably consider the car. This, of course, is not meant to exclude the usual standard equipment of a car, such as speedometer, windshield, top, etc. Shock absorbers, for instance, find little or no market. Surface conditions of the roads are generally good, and the ordinary spring equipment, with perhaps an extra leaf inserted, gives satisfactory riding comfort.

An accessory demanded in Japan, but not usually found on the American car at the present time, is a bulb horn. This is required by the police regulations. Such horns are now being made in quantities in Japan to meet the demand, as are door fittings, foot and robe rails, and other features which generally enter into the home-built closed bodies.

Accessories are generally handled by the firms which have car representations. Just how little demand there is, and how little effort is expended on the sale of accessories, was revealed one afternoon in a call on one of the largest dealers in Tokyo. About half a store front was given up to the accessory department. Articles were displayed in the windows and in cases around the room, but to get into the salesroom it was necessary to obtain the key from the manager. In other words, there was not enough business in this line to warrant keeping a salesman in that room. The stock carried was similar to that usually found in a small garage in an American city, and included only essential parts, such as spark plugs, carbureters, bulb horns, and acetylene gas generators.

Some Suggestions to American Manufacturers

One accessory which might be introduced in Japan is a light dimmer or nonglare lens. At the present time there are no regulations for lights, either in city or country. For the large variety of American extras there is practically no market in Japan, certainly not enough to warrant getting after the business in any way except by correspondence.

In many ways Japanese dealers, at least large firms, are progressive. As an instance of this the action of one of the companies during the season of 1917 is worthy of mention. This firm, which has exclusive selling rights for one of the best-known low-priced American cars, foresaw the possibility of an absolute embargo against the export of American cars after the United States entered the war, or if not absolute prohibition at least insurmountable obstacles that would make shipping even more difficult than it had been up to that time. Accordingly orders were placed for hundreds of cars to be shipped as promptly as possible. These began to arrive in July and followed in quantities for two or three months. Shipping conditions continued to grow worse, but this dealer had on hand plenty of cars for immediate delivery at a time when cars were greatly desired in Japan. After all, the way to get business in Japan is to be able to make immediate deliveries, and this dealer had shown wisdom in following the course he did.

Another company, having decided to take the representation of American cars as a separate division of its established business, ordered 39 cars of different makes by cable as its first samples and devoted practically all of the two lower floors of an extensive building in the very best business portion of Tokyo to the automobile sales. At the suggestion of the writer, this company inaugurated the business with some advertising that has had very little trial in Japan, namely, the mailing of personal announcements. As the firm had been in business for several years and had a large number of names on its books, and the family connections of the principal stockholders were extensive, a good mailing list was available. According to the sales manager of the firm, results were highly satisfactory, numerous prospective customers being secured even before the sample cars had arrived.

Should Avoid Demanding Too Much Business

The American manufacturer should studiously avoid, in his first correspondence with a Japanese dealer, to scare the prospective distributer at the very start by demanding too much business the first year. As an instance in point, a manufacturer, in reply to a dealer's inquiry, said that he believed the Japanese market should be good for 100 cars the first year. The Japanese dealer immediately gained the impression that the manufacturer was trying to make him guarantee to take 100 cars during his first season. He was new to the automobile business and was not in position to guarantee any such amount of business. The writer, feeling that this would be a good connection for the American manufacturer, took it upon himself to assure the dealer that the company would not be arbitrary on this point, and on the strength of this assurance the dealer cabled an order for six sample cars. In less than two months another order was sent for 24 cars, and the Japanese firm seemed to be well on the way to take the suggested number of cars during the first year, but the one suggestion in the first letter almost halted the deal. No doubt the matter could have been straightened out by mail, but it would have meant the delay of three months in getting the business started.

It is well, therefore, in first letters to disregard any suggestions as to the number of cars that should be taken, leaving this with the dealer, or if the question is brought up, care should be taken to let him know that he is not required to take a large number of cars. To a certain extent this may seem contrary to American sales methods, but its wisdom can be found in the fact that the company which is now getting more business in Japan than any other American concern specified a very small number of cars in its first contract and continued with this dealer even though this specified number was not taken the first year.

Must Guard Against Conflicting Lines

Another point which should have the careful attention of every export manager is the matter of conflicting lines. There is one company in Japan which for several years has had the sole selling rights for a low-priced American car. Within the past year it has taken on another line which is in direct competition, there being hardly $100 difference in the price of the two cars. One cannot help but feel that the first car is not getting the representation it should. The manufacturer should know just what cars are being handled by an agent and he should refuse to make a contract when a conflicting line is handled. There is no telling when or on what line "sidetracking" may take place.

A determined effort should be made to live up to all promises made to the dealer. Rash promises are more often made by traveling representatives than in correspondence from the factory, for the traveler is desirous of getting business and is likely to make promises than cannot be fulfilled. The chief complaint along

this line is in the matter of deliveries. Delays, of course, are often caused by circumstances over which neither the traveling man nor the manufacturer have control, but the dealer loses sight of this altogether, and simply feels that he has been promised something which the company has not delivered. The same applies to promises on services, catalogs, and other printed matter. Delays result in a feeling on the part of the dealer that is not to the best interests of the manufacturer.

Better Packing Suggested

Dealers in Japan are generally satisfied with the cars that the American manufacturers are sending them and with the financial terms. There is little protest on the packing, but there is still room for improvement along this line. Cases have arrived badly broken and cars damaged, but there has been vast improvement in packing during the last few years. Heavy packing cases are well worth the extra cost. During the summer of 1917 a shipment of cars, the list price of which in America is more than $1,500, was received in Yokohama. Upon opening these the enamel work on fenders and hood was found to be badly cracked. It looked very much as though these parts had been fitted while still "green." There are instances in which packing paper has stuck to and ruined the finish of the bodies. Certainly the cars should be given time to dry before they are boxed. Instances of this kind, however, are rare; they can easily be guarded against and are well worthy of attention by the manufacturer. When cars are boxed partially disassembled, great care should be exercised to have all parts included in the case.

A subject that has been written up so often that it seems a stereotype of every article on export trade is the matter of postage. It would seem by this time that foreign mail would have at least the necessary amount of stamps to carry it through, but a number of instances can be cited where this is not the case. One dealer, tired of paying excess postage time after time, adopted the policy of returning insufficiently stamped mail. Many important letters were sent back to the company, and there was much delay in the business. A card calling attention to this matter should have a place with "Do it now" and other placards over the mailing desk.

Improvement could be made in the form of the manufacturer's contracts. Contracts made for Japan and foreign trade in general should be made to cover every point, of course, but they could be made somewhat more brief. Most of them are formidable looking documents and contain a lot of conditions that never are and cannot be fulfilled.

During the past year considerable business has been built up in importing used cars into Japan. Honolulu dealers seem to have been the first to discover this plan of ridding their own territory of surplus secondhand cars. According to the Honolulu dealers who are engaged in this business, they have made efforts to ship out only cars that were in fair mechanical condition, endeavoring thereby to develop the trade and clear the field for new cars. Usually these cars are shipped on a blanket order which specifies a certain number of used cars totaling a certain value. That somebody is simply trying to unload junk is evident by some of the vehicles that can be seen on the docks at Yokohama. Honolulu dealers claim that these cars are sent from the Pacific coast. It is certain that unless there is a change this newly discovered outlet for used cars is going to be cut off even before it is fairly started, a circumstance which may be looked upon by the American manufacturer as either favorable or unfavorable.

Use of Tractors Not Practicable

Although the available agricultural land in Japan is intensively cultivated and farming has a big part in the country's industry, there is absolutely no market for farm tractors worthy of consideration. Most of the landholders have small plots, probably more than 50 per cent of the farms being less than 2½ acres in extent.

Rice is of course the principal crop grown, and the manner of preparing the land is decidedly against the use of tractors. The fields are from 60 to 100 ft. square and terraced one plot above another, so that the water used in irrigating may drain from each terrace to the one lower. Moreover, the wages of farm laborers, if help outside the owner's family is required, is so low that the cost of gasoline at 45 cents or more per gallon would prohibit the use of tractors.

Road tractors and trailers also can be given little consideration. Roads are narrow and turns sharp, making almost impossible the handling of road trains.

Refinements in Design to Facilitate Maintenance

By J. Willard Lord

IN the beginning of the industry the designing engineer dominated production engineering—this because every effort was made to build a car that would run. Then production engineering, because of competition, became more and more powerful and slowed up the efforts of the designing engineer to improve the product; which increased production and lowered selling prices.

There is, however, a third element of engineering. On any car built to-day there are one or more parts difficult to take apart because there never was any provision made to apply a puller or heavy wrench or other device which would make it possible to tear down in about the same time as to rebuild. We all know of jobs that can be assembled in twenty minutes but take four hours to get them apart when replacement is necessary, because no adequate means are provided or else the job is buried in the depths of the car, requiring considerable tearing down to get to it.

The neglect of this maintenance element helps run up repair time and charges and makes very difficult the maintenance and service problems, the satisfactory solution of which are so essential to the sales organization and the number of sales made.

In other words, there are three elements of engineering that should bear on the product: 1, Design; 2, production; 3, maintenance.

The third item has not received sufficient attention and thought at headquarters or the factories, maintenance and service often being left to selling agents who are essentially salesmen and not engineers and mechanics.

When designing the "Post War Car" I hope to see

1. *Refinements in engineering*—A lighter, more staunch car, more efficient, roomier and more comfortable.

2. *Refinements in production*—More readily produced and easier to build accurately and hold to close limits. Good design and accuracy mean long life.

3. *Refinements in maintenance*—Adequate provision made to disassemble parts quickly when necessary, provision made to apply various kinds of pullers, wrenches, etc.; due consideration given to tools necessary to make good, quick and accurate repairs.

AUTOMOTIVE INDUSTRIES
The Automobile

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Readjustment

WE are now passing through the period of readjustment. When we meet friends we are wont to ask them what they think of conditions, and what this or that concern, which was heavily engaged in war work, is going to do. In some cases definite conclusions can be drawn while in others this is impossible.

One important fact, however, stands out very plainly, and that is that the period of readjustment is going to be short. It is like a yacht race. Before the starting gun is fired the yachts can only jockey about behind the starting line, but as soon as the starting signal is given they can pass the line and begin the race. Industry is now in the jockeying period. The clever skipper is the one who will put his boat across the line to a flying start, and he is the one who will be just that much ahead when the commercial race begins again.

The war has stimulated business competition. The principal reason for this is that it has reduced practically all concerns in any given line of business to the same level. Old business connections have been done away with in a great many instances, and the office of the purchasing agent will again be the mecca for thousands of traveling salesmen who have busied themselves in the past few months answering letters begging for deliveries on materials ordered months before or turning down orders for future delivery. In other words, business is getting back to a normal state, and it is getting back fast.

The period of readjustment is going to be short, yet it is going to take a measurable length of time. It is easier to tear a house down than it is to build it up, and the same material cannot be used. It is easier to re-organize a business for war with the Government back of you with all the money you need than it is to get back to peace times. The jockeying time will be very short—and then for the commercial race!

Anti-Friction Crankshaft Bearings

ALTHOUGH spasmodic attempts have been made in the past to fit anti-friction bearings to engine crankshafts, the practice has never gained much ground. These bearings are of the greatest advantage on high-speed shafts, and when even the axles of farm tractors are mounted on roller bearings it seems strange that their use on the crankshafts of high-speed engines should not have become popularized.

It is, of course, the general opinion that anti-friction bearings are used because they reduce friction and thus prevent waste of power. This certainly is one of the reasons why they are preferred to plain bearings in many classes of work. But it is to be doubted that they would ever have attained their great popularity in the automotive field if it hadn't been for the fact that they require practically no attention. Just a slight amount of oil applied at long intervals, sufficient to maintain a film over the bright metal surfaces and protect them from rust is all that is required. A plain bearing, on the other hand, must be constantly kept well lubricated or it will soon wear out and give trouble. Therefore, where it is difficult to insure a constant supply of oil to the bearing it is advantageous to use an anti-friction bearing which does not need it.

In an automobile engine having a completely closed crankcase, and where the lubrication of the cylinders is effected by means of the splash or spray of oil in the case, the lubrication of the crankshaft bearings is easily taken care of. The ordinary circulating splash system is simplicity itself, and even if the bearings required no lubrication, all of its elements would have to be provided to take care of cylinder lubrication. Therefore, the use of ball bearings on the crankshaft would not reduce the amount of attention that must be given to crankcase lubrication.

Another reason why anti-friction bearings are not used is the difficulties connected with mounting them on the crankpins and intermediate journals. The

bearings must either be stripped over the crank arms, which necessitates the use of bearings of very large size, together with split filling rings or bushings, or the crankshaft must be built up. Both of these constructions are rather expensive. At the present time ball or roller bearings are used only on engines with only one or two main bearings, in which the mounting difficulty does not arise.

In single and double-cylinder engines roller bearings are occasionally used on the crankpins. Where the crankpin is a separate piece it can readily be hardened and ground and the rolls can bear directly on it, so that the outside diameter of the bearing is not appreciably increased. But if a ball or roller bearing had to be stripped over the crank arms it would have to be of large size, which not only would increase the necessary size of the crankcase and add to its weight, but also add to the centrifugal mass, thus increasing the bearing loads.

It is thus seen that the fitting of anti-friction bearings to multi-throw crankshafts is hedged about with difficulties, and though the reduction in frictional losses which their use would insure would be desirable, the consensus of opinion among automotive engineers is that it does not warrant the expense involved.

Double vs. Single Valves

A GOOD deal of valuable research work has been done at scientific laboratories in this country in regard to problems arising in connection with war work. While the war lasted it would have been poor policy to publish the results obtained, but now that it is over we may expect to see considerable material of value to the engineering fraternity released.

In another part of this issue we reprint a part of a report on an investigation of the subject of air flow through poppet valves. This problem arises in the design of explosion engines, and especially of aircraft engines, when the relative advantages of a single large diameter and two smaller valves are considered. So far we have considered the flow to be proportional, under a given head, to the actual area of valve opening. It has generally been admitted that a very narrow annular opening, such as obtained with a large diameter and small lift, would not be quite equal to an opening of equal area obtained by the use of a smaller diameter valve of greater lift, but just how much effect the form of the opening had on the flow has been conjectural.

While the investigation referred to was made under the condition of steady flow, instead of under interrupted flow as obtains in a combustion engine, we are fairly safe in assuming that the results obtained are indicative of what may be expected in an engine. They have definitely shown that a relatively high lift is a great aid in obtaining high volumetric efficiency. Heretofore it was generally assumed that a lift equal to one-quarter the valve port bore, giving a valve opening equal to the valve port area, did not restrict the flow of air in any way. The investigation showed that with a lift equal to one-quarter the valve diameter the flow is less than 67 per cent of what it would be if the valve were entirely removed, and with a lift equal to one-half the diameter it is equal to between 80 and 90 per cent of the flow through the unobstructed port. Evidently it requires an infinite lift to give a flow equal to that through the unobstructed port and with any moderate lift there is a reduction of the flow.

A relation that has been definitely established is that with the lift proportional to the diameter the flow through a valve is proportional to the square of the diameter, or, in other words, to the area of the valve port. On the other hand, with a constant lift not exceeding one-quarter the port diameter, the flow varies only about as the 4/3 power of the port diameter. It is under this condition, that is if the lift can be maintained constant, that double valves are of the greatest advantage over a single valve.

War Truck Repair Shops

THE war has resulted in the building of a number of immense automobile repair plants, and now that hostilities have ceased some of these will be of very little use. This seems to apply particularly to a partly completed repair works at Slough in England. Most of the plants at which the British transport vehicles were kept in repair were located not so very far behind the lines in France, but last spring when the Germans made their great drive and advanced to within a few miles of Amiens, these repair depots were seriously threatened, and to provide for all possibilities it was decided to erect a large plant in England. An idea of the immensity of the proposed plant may be gained when it is stated that the plans called for an area of no less than 15 acres under roof.

When the tide of the German advance was turned and it became apparent that the plant would not really be required, its erection became a matter of some concern to British automobile and truck manufacturers, and their anxieties are voiced in an article in a leading engineering paper. Should the Government complete the works about the only use it would have for them, now that the war is over, would be in the repair of the thousands of war-worn military trucks and automobiles. The automobile manufacturers, on the other hand, feel that during the early reconstruction period they cannot immediately get back to 100 per cent peace time production, and if they could secure the business of rebuilding or overhauling the war trucks it would serve to help tide them over this period of readjustment. Therefore they are urging that the Slough project should be dropped.

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GREAT inroads have been made on the timber supplies of the leading European countries during the past four years and as a result wood construction will undoubtedly be more and more replaced by metal construction. In Great Britain about one-half of the forests were cut down during the war.

□ Latest News of the

England Sees Certain Development of Commercial Aviation

Plans Already Being Made for Mail, Express and Passenger Transportation Over Routes from London to Scotland, France, Ireland, Russia, Africa, India and Australia—Problems of Laws Being Considered

By David Beecroft*

LONDON, Nov. 25—(Special to AUTOMOTIVE INDUSTRIES)—Post-war aircraft activities are taking more definite form since the signing of the armistice and it is now generally conceded that commercial aviation is certain to make very rapid progress.

A report was made some time ago by a committee known as the Civil Aerial Transport Committee, and the presentation of this report to Parliament this week has opened the door for a few of its broader considerations, although the complete report has not yet been published.

The committee has six definite conclusions regarding commercial aviation, which include a business flying speed of 100 m.p.h., stages of 500 miles or thereabouts as the ideal distance for limits of flight, arranging facilities for night flying, and providing of both land and air brakes to meet landing conditions.

The six conclusions of the committee are:

(1) That for commercial success speed is probably the most material factor.
(2) That for commercial success the speed needed depends very largely on the conditions of competing methods. Between large centers connected by direct high speed railways, speeds of 100 miles per hour are desirable; but for linking places between which the railway service is slow or interrupted by sea crossings, lower speeds will be found commercially practicable.
(3) That at present stages of about 500 miles would be the normal limit, but that it will be desirable from the commercial point of view that stages should be as long as possible.
(4) That it is desirable as speedily as possible to develop the existing facilities for night flying, especially for the carriage of mails.
(5) That heavy loading is necessary for commercial success, but since this will involve a high landing speed, development of land and air brakes is necessary.
(6) That in view of certain disadvantages of high landing speed, efforts should be made to keep loading as low as possible consistent with securing a commercial rate of speed, and to provide for aerodromes and landing places possessing the best possible surfaces, and that it may well be hoped that future inventions and improvements in design will enable a lower landing speed to be attained without sacrifice of flying speed.

The door is just opening on the possibilities of commercial aviation, and no one to-day can foresee the widening future that awaits it. U. to the present invention has largely had to do with war development, but from this date forward the needs of peace and commerce will be the spurs to invention.

It is generally recognized that the large capacity planes are to be the leaders in commerce and that the possible field of commercial aviation embraces—

a—*An express letter mail which will compete in speed with telegraph service and constitute a new aspect of postal service.*

b—*Passenger service that will afford very high sustained speeds over long distances, particularly where water routes are included.*

c—*Carrying of such ordinary merchandise as commercial samples which otherwise would require a long time for transporting.*

Undoubtedly the light machines with capacity for one or two passengers will furnish the immediate call for passenger service, and following such service will be the installation of large machines for scheduled service.

The recent performance of the monster Handley-Page carrying forty passengers over the City of London is a suggestion of what may be in store in the near future. Such a machine with its four engines, giving a total of 1400 horsepower and with its wing spread of 137 ft. and a sustained speed of over 100 m.p.h., is indicative of what invention will bring out.

The garaging of such an aerial monster is facilitated by the use of hinged wings which swing back parallel with the fuselage and give a very compact machine.

Innumerable problems are bound to arise with regard to the manifold tasks lying ahead, but already Great Britain has had committees working on them, and while nothing tangible has come out of the committee further than some resolutions, these convey some conception of what must be looked for.

The problem of aerodromes across the length and width of those sections of the country called for by aerial transportation is one of these. A committee working on this problem has concluded that the following points should be kept in mind with regard to location of aerodromes. Landing grounds should—

(1) Bear some reference to the direction of the main aerial routes;
(2) Be sufficiently far from the centers of cities to be fairly clear of houses in the direction of flight;
(3) Be unlikely to be shut in by buildings in the immediate future;
(4) Be as far as possible clear of railways, telegraphs, trees, and other obstructions;
(5) Be situated on ground as far as possible free from mist or fogs;
(6) Be provided with adequate water supply, telephone connections, and good facilities for rail, tram, omnibus and motor traffic with the different districts of the cities to be visited;
(7) Be capable of expansion.

The Second Committee also came to the conclusion that the use of aircraft would be advantageous:

(1) In the case of mails, by competing with the telegraph service, or by establishing a new type of express letter service;
(2) In the case of passengers, by affording rapid transit over long distances, particularly where the journey includes a sea crossing; and
(3) By enabling ordinary merchandise, commercial samples, etc., to be carried more rapidly than by any other means.

(*Continued on page* 1073)

David Beecroft, Directing Editor of AUTOMOTIVE INDUSTRIES, is at present in Europe as one of a party of Business Paper representatives, called to the other side by invitation of the Allied Governments.

Postpone S. A. E. Winter Meeting

NEW YORK, Dec. 16—The winter meeting of the Society of Automotive Engineers has been postponed. The new dates are Feb. 4 to 6 instead of Jan. 12 to 14. The Victory Dinner will be held at the Hotel Astor, Feb. 6. The change in dates has been made so that the meetings will be held during the New York automobile show, which is to be held in the Madison Square Garden and the Sixty-ninth Regiment Armory during the first two weeks of February.

—

Sales of War Materials

WASHINGTON, Dec. 13—Secretary Baker emphasized yesterday that War Department plans for disposition of surplus stocks of raw materials contemplate the absorption of these stocks by the ordinary peace-time industries of the country in such a way as will prevent economic disturbance. In letting go of its considerable holdings of copper, steel, lead or similar products, Mr. Baker said, the War Department will consult both the producers and the consumers of these commodities.

—

Soldiers in Aviation Service Discharged

WASHINGTON, Dec. 16—Thirteen thousand soldiers in the Division of Military Aeronautics, 30,000 engaged in spruce production, and 7000 in the Tank Corps are among the enlisted men designated for immediate discharge from the army, according to a statement made here to-day by General March.

Automotive Industries

Goodyear Patent Is Not Infringed

Firestone Does Not Infringe—Some Claims Invalid, Others Not Infringed

NEW YORK, Dec. 18—Many of the claims of the Goodyear tire machine patent, over which the Goodyear Tire & Rubber Co. started suit against the Firestone Tire & Rubber Co. in 1914, have been declared invalid, and certain other claims alleged to be infringed are held not infringed. This decision, rendered last week by the United States Circuit Court of Appeals, reverses the opinion of Judge Killets when in May, 1916, he held the patents valid and infringed by Firestone. At that time, and pending final decision, Firestone was placed under a bond of $225,000.

The decision is an important one, inasmuch as it covers what where alleged to be basic patents covering tire making machinery. Immediately following the earlier decision a very considerable number of companies acknowledged the apparent finality of the opinion and arranged with Goodyear to operate under the patents. These included such well-known makes as United States, Revere, Federal, Fisk, Empire, Howe, Kokomo, Mason, General (Akron), Portage and others.

To quote a Goodyear official, the effect of the decision is that Goodyear is "temporarily licked"; it is intimated that the litigation may be carried further. It is possible for the case to be brought before the Supreme Court of the United States on a writ of certorari.

The patents in suit were one issued to Seiberling and Stevens on June 14, 1904, No. 762,561, and one issued to Seiberling Nov. 30, 1909, No. 941,962, the latter issued upon application made by the State. In the original decision Judge Killets held valid and infringed claims 1, 2 and 14 of the earlier patents and sixteen claims of the later patent. Under the new decision claim 1 of the Seiberling-Stevens patent was held not infringed and claims 2 and 4 are held invalid for want of invention; claim 14 "does not differ from the second in any respect now material." Of the State patent claim 4 "and all other claims sued upon (except the 15, 17 and perhaps the 11)" are held invalid.

In the original suit the Goodyear company contended that the Seiberling-Stevens machine was the pioneer and that it paved the way for the modern semi-automatic tire making machine; that it was the first machine ever produced to make automobile tires, and that while the majority of the tire makers have been building their tires on machines licensed under the Goodyear patents, a few, among them the Firestone Co., refused to conceive the validity of the Goodyear patent. The purpose of the machine was to supplant the uncertain and inefficient results of hand work by stretching the fabric layers and uniformly placing them by machine processes.

Pending the appeal, all the exhibits were removed to the Federal Court at Cincinnati and the tire machines were set up side by side for the edification of the judges. During the argument of the case early in 1917 the full bench of judges viewed the manufacture of tire casings as carried on in the Goodyear and Firestone factories.

After the argument but before the court had rendered its opinion, Firestone discovered new evidence in the form of a Belgian patent of 1906 issued to a Frenchman named Mathern. The utilization of this patent was impracticable before this time beacuse of the European war. The case was reported to consider the Belgian patent and its effect upon the State patent in suit. A replica of the Mathern machine, the original having been purchased by Firestone from Mathern in 1909, was set up beside the more modern machines and operated with them before the court.

—

Makers Pay $23,981,368 Taxes

WASHINGTON, Dec. 18—Automobile manufacturers paid the United States Government $23,981,368.35 for the year ended June 30, 1918, under the 3 per cent revenue tax. Of this amount more than 60 per cent came from the State of Michigan, which paid $14,711,373.33.

—

General Motors Building Three Tractors

NEW YORK, Dec. 19—In addition to the 2-3 and 3-4 plow tractors brought out recently by the General Motors Corp., which were described briefly in AUTOMOTIVE INDUSTRIES of November 28, a third model, known as type D, is being introduced. Model D is a small tractor or motor-cultivator designed to operate existing horse-drawn farm implements of regular type. It will sell for $450. It is understood that later on a complete range of especially designed and low-priced farm implements for model D will be marketed. Model M, the 2-3 plow type, is priced at $650 and the larger model is $900. Arrangements are being made to distribute these tractors on a basis of limited allocation to each State. About 10,000 tractors of the three models will be produced during the next four months by the new factory at Janesville, Wis.

—

Col. Mars Heads Aircraft Production

WASHINGTON, Dec. 19—Lieut. Col. J. A. Mars has been appointed director of the Bureau of Aircraft Production, taking the place of W. G. Potter, who has resigned as was previously announced. Col. Mars is a regular army officer.

Makers Slowly Quit War Work

Efforts Turned Toward Rebuilding Sales Organization —Truck Makers Active

DETROIT, Dec. 17—Manufacturers in this district are congratulating themselves or otherwise, depending on their ability to get out of war work and back into their customary peace lines. Shell contracts and other ordnance work is not being cancelled as rapidly as the work for the Bureau of Aircraft Production. Quartermasters' supplies are also being manufactured with scarcely any sign of a decrease.

While finishing up the odds and ends of war contracts, manufacturers are seriously engaged in an endeavor to rebuild their somewhat shattered sales organizations. Service departments of dealers have been hit even harder than sales departments, and to get both back on a somewhat normal basis is proving a tremendous task. The report which seems to have circulated in some localities that dealers throughout the country are overstocked is discounted here. Both in the high-priced and low-priced lines it is stated that dealers have not enough cars to meet demands, even though that demand is below normal.

Manufacturers like Cadillac and Dodge, whose plants were undisturbed by war work because the Government took their commercial product practically as it stood, are in a fortunate position. There are quite a few others who are also able to turn their plants directly into peace work without an internal reorganization. The plants in this situation are simply going ahead with their pre-war plans as if they had never been interrupted.

The Essex car, which will be built in the Hudson plant and sold largely through the Hudson dealer organization, is being shipped to distributers. This car will sell for $1,395, which is the price placed upon it before manufacture was curtailed.

The small Overland model is now going through production and will be vigorously marketed within a few weeks. Beside these two, which are really not new models but simply models which were temporarily held out of manufacture pending the release of steel, there is no prospect for any marked introduction of new products until spring, and it is doubtful if there will be many until later in the year. The war ended so suddenly and the engineering brains of the country were so taken up with war work that there was no opportunity for

design and development during the war period. The result is that the new designs are just getting down on the drafting boards at the present time, and it will be spring before the experimental models are on the road.

Truck manufacturers will doubtless be rounding out their lines within the next few months. The Acason company is just about to start production on a new 1-ton design and it is expected that several other truck companies will have more complete lines as soon as they are able to free themselves from war orders.

A situation which is bothering passenger car manufacturers is the seeming expectancy on the part of the general public of big price reductions in the near future. This has resulted in tying up buyers who would otherwise be ordering cars. To combat this, a vigorous campaign is being pushed by manufacturers generally to bring before the public the knowledge that there will be no general price cut for months to come. Maxwell and Chalmers have guaranteed their prices to be stationary until June, 1919, and this stand will also be taken by many others who desire to clear up the impression that automobiles are due for a marked decrease in prices.

A very interesting phase which indicates the spirit of the manufacturer at the present time is the keen study being given to the subject of tractor manufacture. There is a marked tendency on the part of the larger factory to spread out into truck and tractor manufacture. This was noted to some extent before the United States entered the war, when companies such as the Maxwell Motors Corp. brought out a tractor. The General Motors Co. has already announced its intention of manufacturing a low-priced tractor on a large scale, and the Maxwell company will be ready to go ahead with it as soon as it is able to clear up its war contracts.

An embarrassing situation in regard to cancellations has arisen in connection with concerns which are making their standard product for the government. Many of these concerns had brought out new designs or altered designs, which were intended for the commercial market. Cancellations in whole or in part have caused large quantities of surplus material to gather which must be used up before the altered designs can be put into production.

Endorse Federal Road Commission

Chicago Meeting Unanimously in Favor of It—Graham Proposes Uniform Law

CHICAGO, Dec. 13—A Federal Highways Commission was proposed and definitely assured of the support of the Highways Industries Association and the Association of State Highway Officials at the three-day joint session of these bodies which was brought to a close to-night. As was forecast in AUTOMOTIVE INDUSTRIES last week, the meeting came out unequivocally in favor of the appointment of such a commission, which would be formed of five big, broad-minded men upon whom would devolve the duty of mapping, building and maintaining a system of national roads approximating 50,000 miles, to serve fully 90 per cent of the population of the United States, to cost in the neighborhood of $25,000 a mile and to be fed by a system of state and county roads built by the individual states and counties with aid from the Federal Government.

With a view to encouraging and stimulating the already rapidly expanding use of trucks for interstate highway transportation, George M. Graham, president of the Pierce-Arrow Motor Car Co., proposed a uniform vehicle law which would wipe out the disadvantages under which interstate highway shippers now operate because of the great diversity of individual state laws.

Must Fit Trucks to Road

Referring to the alleged damage done to roads by trucks, Graham stated that the truck is as much sinned against as sinning. As a means to fit the trucks to the road, Graham suggests a minimum allowable weight for any truck with body and load of 24,000 lb. and that a plate giving the maximum allowable weight of any truck be attached to the vehicle. Exceeding this weight would be considered prima facie evidence of a misdemeanor.

Trailers also would be included under this measure. Below are the recommendations which Graham makes and which he would see incorporated in uniform motor vehicle laws to be passed by the individual states.

Height	12 ft. 6 in.
Width	96 in.
Weight, Vehicle, Body and Load**	24,000 lb.
Weight on tire per inch of width	800 lb.

Speed (M.P.H.)	Maximum	Suburban	City
Pneumatic tired vehicles under 6000 lb.	30	20	15
Other pneumatic tired vehicles	25	20	15
Solid tired vehicles:, 4000 to 28,000 lb*	25	15	12
Buses:			
6000 lb.	30	20	15
7000 lb.	30	18	16
8000 lb.	25	20	12
Trailers:	Same as Trucks		
*With following exceptions:			
4000 lb.	25	20	18
8000 lb.	20	18	15
12,000 lb.	18	15	12
16,000 lb.	16	15	12

**Highway Commissioner has discretionary power to increase this weight to 28,000 or more, depending on condition of roads.

Oil Industry Asked to Lift Restrictions

WASHINGTON, Dec. 16—The Fuel Administration has asked the oil industry to lift all its voluntary restrictions on crude oil prices and distribution and on refined products. This removes the entire oil industry from Government supervision. Unless events prove the necessity of again exercising control, says the announcement, this release will be permanent. The Administration points out, however, that licenses now outstanding will remain in force until the President's proclamation of peace, and all agreements made heretofore will continue subject to cancellation or assignment on request of the Fuel Administration. The allocation of supplies of petroleum products for the Allies will end Feb. 1 and the priority orders for export of gasoline and kerosene will expire at the same time. However, the allocation of aviation gasoline for the Allies and the American Expeditionary Forces will continue until further notice is given.

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S. A. E. Visits Standard Aircraft Plant

NEW YORK, Dec. 16—At the invitation of the Standard Aircraft Corporation, 80 members of the Metropolitan section of the S. A. E. paid a visit to the plant at Elizabeth, N. J., to-day. During the morning, a tour of inspection was made through the various shops under the guidance of J. M. Meirick, superintendent of publicity, and B. L. Williams and other officials of the company. The visitors were shown through the wing and body shops, inspection, assembly and testing departments, where several H. S. 2 L. flying boats, Handley-Page giant airplanes and De Havilands are in process of construction. All of these are equipped with Liberty engines.

After a lunch provided for the visitors in a large dining room capable of seating 800, built for the officers and office staff of the company, the visitors were shown motion pictures which have just been taken in connection with Government publicity, depicting the work in the plant. Another picture showed the launching of the first American-made Handley-Page airplane, the Langley, which was made at this plant in ninety days and flown July 6.

H. B. Mingle, president of the company, made a short address to the S. A. E. members in which he expressed the hope that the company would be able to continue building airplanes for commercial uses. The company is now completing its Government contracts, and already the force of men has been considerably reduced. At the period of maximum production between 4,000 and 5,000 men and women were employed.

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Shuler Moves to Louisville

DETROIT, Dec. 18—The Shuler Axle Mfg. Co. has removed its entire business and equipment from this city to a new plant in Louisville, Ky.

To Validate "Illegal" Contracts

Measure Introduced to Insure Payment on Contracts Made Verbally or by Wire

WASHINGTON, Dec. 16—Important Congressional activities are expected this week that will affect automotive industries and war manufacturers generally. Opposition to the appropriation of $2,185,000 for increased airplane mail service and for $1,000,000 for extended motor truck mail service is expected to provoke keen discussion on the floor of the House.

In addition a very important bill introduced last week by Congressman Dent to provide relief for the War Department and allow it to make payments where Army contracts have not been made for war materials will come up.

This bill was introduced into the House to remove the present obstacle created by Controller Warwick of the Treasury, when he informed the War Department that he would not honor contracts that had not been "legally" executed, such as contracts that were made over long distance telephone verbally, or by telegraph, etc. Briefly, it authorizes the Secretary of War or his agents to accept and pay for articles or merchandise which had been ordered for the prosecution of the war but for which contracts had not been "legally" made.

The bill was discussed before the Committee on Military Affairs late last week by the Committee and Benedict Crowell, Assistant Secretary of War, Major General George W. Goethals, Director of Purchase, G. H. Dorr, Assistant Director of Maintenance, and Controller of the Treasury Walter W. Warwick.

The chief objection to the bill arising in the discussion was that it was too broad and allowed too free interpretation. It was further opposed in this meeting because it confers judicial powers on the Secretary of War, making the allowances provided by the Secretary of War final and conclusive.

There are three classes of contracts which enter under the "illegal" class, according to General Goethals:

1—Where a contract has been made and not signed by the proper officers, and where the contractor has delivered his material and been paid for it and the payments are illegal because the contract was not regularly signed.

2—Where the Government has received materials, signed no contract, and made no payments.

3—Where an order has been given to a contractor to make preparations to go to work, where he has expended the money, but delivered nothing under the contract at the time the armistice was signed.

General Goethals stated that it would be impossible at this time to tell how many contracts had been entered under these classes or their value but he estimated that there were thousands of contracts and millions of dollars involved.

It developed at the hearing that following the Spanish-American war a similar condition arose and many cases arising at that time are still in the Court of Claims, and, said the War Department officials, they are trying by means of this new bill to avoid a similar condition with the consequent business troubles that would arise.

Congressman Caldwell objected to the bill because he said there is no provision restraining the Secretary of War and further because the people who will pass on the contracts are, in many instances, or were, connected with companies involved, prior to the war.

The bill will come up this week and according to business men in Washington, there is urgent need that it be passed promptly by Congress or amended and passed promptly. Hundreds of manufacturers have been in Washington in the last few days solely on this matter and they state it creates a most perplexing problem for them particularly because their banks are fearful due to the doubt raised as to whether the manufacturers will receive just payment or not, and furthermore because in many cases the contractors have sub-contract arrangements which they are obliged to honor while their own arrangements with the Government are not being honored.

Following is the bill: "Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That where during the present emergency and prior to November 12, 1918, an individual, firm or corporation has made an agreement with officers or agents acting under authority of the Secretary of War for the purchase or use of land or improvements thereon, the manufacture or sale of equipment, material, or supplies for services rendered, or other lawful purposes connected with the prosecution of the war, and said agreement has been partly or wholly performed or expense has been incurred by the individual, firm or corporation in preparation for such performance, and, notwithstanding said agreement, has not been made in the form, or signed in the manner required by law, it shall be lawful to make payments under the terms of said agreement to the extent that performance thereof has heretofore been received and accepted by the United States or shall hereafter be received or accepted by officers or agents acting under authority of the Secretary of War, if the latter shall find the public interest require such acceptance;

"Provided that payment under such informal agreement shall not exceed the fair value of the property transferred or delivered and accepted by the United States, as determined by the Secretary of War, and where no property has been transferred, delivered, or accepted payment shall not be in excess of the actual cost incurred in preparation for performance as such cost is determined by said Secretary:

"Provided further, that no liability shall be incurred by the United States by reason of the passage of this Act, excepting such amount only as the Secretary of War shall find to be fairly and equitably payable under such agreement, which amount when received and accepted shall be in full of all claims and demands whatever arising out of or by virtue of such agreement, and nothing in this Act shall be construed to confer jurisdiction upon any court to entertain a suit against the United States upon any agreement of the character herein referred to, but the allowance made by the Secretary of War shall be final and conclusive."

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WASHINGTON, Dec. 18—The House Military Affairs Committee to-day authorized Congressman Dent, chairman, to draw up a bill which will allow the Treasury Department to pay manufacturers who hold Government contracts which were not legally executed and which have been held up heretofore by a decision of the Controller of the Treasury. The new bill will be a modification of the bill presented last week on this matter.

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Would Place Air Mail Under Army

WASHINGTON, Dec. 18—That the Government would save many millions of dollars by operating its air mail service under the supervision of the Army instead of the Post Office was maintained yesterday on the floor of the House by Representative La Guardia of New York, recently a Major in the Aviation Service. Congressman La Guardia, who favors an air mail service but opposes what he terms needless expenditure of millions of dollars for the Post Office Department to experiment with planes and train personnel when the Army and Navy Marine Corps already have established air organizations, promised the House a more extended talk on this matter in the near future, at which time he said he would give "the inside story."

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Use Argon for Aircraft

WASHINGTON, Dec. 18—The Navy Department is building a plant at Fort Worth, Texas, for the production of argon from natural gas for use in lighter-than-air aircraft. Argon is an inert, non-inflammable element without the hazard of fire or explosion.

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Truscon Enters General Field

DETROIT, Dec. 18—The Truscon Steel Co., which for a number of years has been producing pressed steel parts primarily for use in its own products, is entering the market and is prepared to furnish pressed steel parts of various kinds for other manufacturers.

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N. A. P. A. Branch in Kansas City

KANSAS CITY, Dec. 15—The twenty-second branch of the National Association of Purchasing Agents was organized in Kansas City Dec. 10, with the following temporary officers: President, M. E. Wilcox, Weber Engine Co.; secretary, E. E. Stigall, Kansas City Railways Co. The following visitors assisted the 25 local purchasing agents in effecting the organization: D. D. Ranken, assistant purchasing agent of the Du Pont companies, president of the National Association of Purchasing Agents; L. F. Boffey, editor of The Purchasing Agent, secretary of the national society; J. C. Densmore, purchasing agent of the University of Chicago, treasurer of the national association, and J. A. Hecker of the Curtis Mfg. Co., secretary of the St. Louis branch of the national organization.

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Klaxon Equipment Division for Detroit

DETROIT, Dec. 18—The Klaxon Co. has established a general sales office for its motor equipment division at 3066 W. Grand Blvd., Detroit. It will be in charge of Frank B. Ruff.

England Plans Post-War Show

Will Stage Event at Olympia Hall in November—Aviation Exhibits Likely

LONDON, Nov. 24—Special to AUTOMOTIVE INDUSTRIES—Within just one week from the announcement of the armistice terms the motor trade in England decided on a program of exhibitions for next year, the time being too short to hold the usual Olympia exhibition this November in accordance with pre-war rules.

The first post-war exhibition will be held in November, 1919, at the Olympia Hall, and while many post-war models will be marketed long before that date and are actually being announced now, that date will mark the first great bringing together of the post-war models. The Society of Motor Manufacturers and Traders will handle the show.

Other exhibitions are being discussed but dates have not been fixed. The increased importance of motor trucks and farm tractors points to a combined exposition of such vehicles at which will also be exhibited farm machinery specially designed for use with motor tractors.

Aviation expositions will be held throughout the British Isles. The lack of public interest in aircraft which existed previous to 1914 is now passed and aviation exhibitions will without doubt be great events, particularly as it is now recognized that there are many commercial uses for the airplane.

The war has added much stimulus to motor boating and some form of national motor boat and marine exhibit is being discussed. Such an exhibit in addition to catering to pleasure craft will include motor barges, fishing vessels and many other types using the explosion engine.

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Republic Issues $3,000,000 Notes

NEW YORK, Dec. 17—The Republic Motor Truck Co., Alma, Mich., has issued $3,000,000 of first mortgage and collateral trust 7 per cent serial gold notes for the purpose of reducing current floating indebtedness and to provide additional working capital for the further expansion of the business. Maturities are as follows: Series A, $500,000, Nov. 1, 1920; series B, $500,000, Nov. 1, 1921; series C, $1,000,000, Nov. 1, 1922; series D, $1,000,000, Nov. 1, 1923.

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Fiat's After-War Policy

NEW YORK, Dec. 16—There has been some speculation as to what would be the post-war program of the Fiat Co., Turin, Italy. It is not the intention of the company to concentrate on a single model; the number of types, however, has been reduced to what is considered to be a minimum. The lowest-priced vehicle will be a light car, a special type of two-seater developed to meet European conditions. For the full touring model the engineers have decided on the 6-cylinder engine in preference to the 8 or 12. It has been decided that all models, from the cheapest to the most expensive, shall be fitted with electric lighting and starting specially designed for that particular chassis. Another mechanical change of interest is the adoption of detachable cylinder heads.

The after-the-war models are as follows:

	Model 500	Model 501	Model 502	Model 503
Engine, vertical monobloc	4 cyl.	4 cyl.	6 cyl.	6 cyl.
Horsepower	8-12	12-16	25-35	35-45
Weight, complete with touring body (lbs)	1200	1900	3100	3900
Speed with full touring body (miles)	38-40	44-47	50-56	56-63
Wheelbase (in.)	95	105	130	143
Track (in.)	43	49	55	43

Commercial vehicles will form a separate and distinct branch of the Fiat after-the-war production. An agricultural tractor department has already been established and tractors are being supplied to the public.

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Price Changes

Overland Reduces Price $110

TOLEDO, O., Dec. 15—The Willys-Overland Co. has reduced the price of its Model 90 touring car, effective immediately, from $1,095 to $985.

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Cole Price Reduction of $300

INDIANAPOLIS, Dec. 15—The Cole Motor Car Co. has reduced prices on all models of the Aero-Eight, effective at once. New and former prices follow:

Model	New Price	Old Price
871, roadster	$2,595	$2,895
872, 4-pass.	2,595	2,895
870, 7-pass.	2,595	2,895
Sedan	3,595	3,895
Limousine	3,695	3,995
Coupe	3,795	4,095
Town car	3,795	4,095

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Velie Prices Reduced

NEW YORK, Dec. 16—The Velie Motor Vehicle Co. has reduced the prices of its two models $75 and $65 respectively, effective at once. Following are the new and old prices:

Model	New Price	Old Price
38, 2- and 5-pass.	$1465	$1540
39, 4-pass. sport	1975	2040

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Selden Trucks Go Up

ROCHESTER, Dec. 16—The Selden Truck Sales Co. has revised its price list. Following are the new prices effective Jan. 1:

Model	New Price	Old Price
TXR, 1-ton int.-gear	$1900	....
TWL, 1-ton worm-gear	2200	$2100
JCB, 2-ton int.-gear	2750	....
JWB, 2-ton worm-gear	3050	2950
NL, 3½-ton worm-gear	3850	3650
DL, 5-ton worm-gear	5000	4950

Chicago Show Dates Jan. 25-Feb. 1.

Dealers Get Coliseum and Armory—Garden and Armory for New York Event

CHICAGO, Dec. 18—The Chicago Automobile Dealers' Assn. has completed all arrangements and set the dates for its show. The event will be held in the Coliseum and the First Regiment Armory as in previous years, with the first week, Jan. 25 to Feb. 1, devoted to passenger cars and the second week, Feb. 3 to 6, devoted to trucks.

The annual meeting of the National Association of Automobile Dealers will be held in the Hotel La Salle during the show, the dates being Jan. 28 and 29. During the New York show the N. A. D. A. will hold an eastern division meeting. The date probably will be Feb. 5.

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NEW YORK, Dec. 16—In addition to Madison Square Garden the New York Automobile Dealers Association has secured the 69th Regiment Armory in which to house its big exhibit Feb. 1 to 15. The 69th Regiment Armory is a short square distant from the Garden and contains more space than there is in the Garden, which more than doubles the original size of the show.

The dual show will be equally good in both buildings. The armory exhibition is not to be an overflow, but an exhibition on an equal basis with the Garden show, with some of the best known cars in the industry in each building.

Manager Charles A. Stewart, who is operating in the association offices in the Woodward Hotel Annex at Broadway and Fifty-fifth Street, states that there will be quite an automotive equipment show in both buildings. In place of the usual 10 x 10 spaces given to the accessory people the spaces this year are to be 12½ x 12½, and in the armory they will all be arranged around the outside of the main floor. In the Garden the spaces will be in the gallery directly above the boxes.

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Bosch Brings $4,150,000

NEW YORK, Dec. 18—The plant and business of the Bosch Magneto Co. was sold last week by Alien Property Custodian Palmer for $4,150,000. It is stated that the company has been bought in by present interests and that it will be continued practically without change.

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Burnett Returns to Cadillac

DETROIT, Dec. 18—Leo N. Burnett has been released from active service in the Navy and returns to the Cadillac Motor Car Co. to resume charge of the advertising department. John A. Cleary, who was borrowed from the Automobile Sales Corp., Philadelphia, to fill Mr. Burnett's post for the duration of the war, has again taken up his duties as sales promotion manager for the Philadelphia concern.

Further Light on Airplane Production History

Lieut. Emmons Reveals Details of Engine and Plane Plans—Life of Liberty Engine Put at Sixty Days—Foreign Estimate of Cost $20 Per Horsepower

WASHINGTON, Dec. 16—At a meeting held last Saturday further outlining the airplane engine production during the war Lieut. H. H. Emmons, U. S. N., added interesting information to the official history of aircraft production which was published in AUTOMOTIVE INDUSTRIES recently.

A Liberty airplane engine, said Lieutenant Emmons, consumes an average of 20 to 25 gal. of gasoline per hour, depending upon the altitude, speed, etc. The original program for airplanes standing at the time war was declared, said Lieutenant Emmons, called for 332 planes. This was shortly after increased to 1000 planes, and then 3 weeks after the declaration of war, and following the receipt of information from abroad, the program was increased to 22,000 planes and was immediately approved by the Secretary of War.

Great Quantity of Tools

In describing the difficulties encountered in the production of the Liberty engine, the lieutenant told that 2500 to 3000 jigs, tools, etc., had to be designed and manufactured especially for each manufacturer engaged in Liberty engine production, and from 80 to 85 per cent of these first made were found to be useless through poor work.

He stated that Major J. G. Heaslett, formerly of the Studebaker Corp., and during the war in complete charge of inspection, production and engineering at Detroit, was the man who was directly responsible for the large production of airplane engines which resulted up to the signing of the armistice. Major Heaslett, he said, working with a committee composed of H. M. Leland, Lincoln Motors Co.; C. H. Wills, Ford Motor Co., and Messrs. Bell and Roberts, of the Packard Motor Co., had full charge and complete authority for all engine production, and it was because of the work of this committee and of Major Heaslett that production amounted to 31,814 engines up to Nov. 11, 1918.

The Liberty engine, said Lieutenant Emmons, is rated at 410 hp., but often reaches 475 hp., and in several instances under special conditions has been developed to produce 526 hp. Its life at the front is estimated at 60 days. Airplane mechanics are instructed to overhaul at least once every 50 hours as compared with an overhaul every 20 hours with other airplane engines. The highest endurance record made by an airplane equipped with a Liberty engine was 162 hours in the air.

In discussing costs Lieutenant Emmons stated that the foreign nations figure the cost of an engine at $20 per horsepower. This would have placed the cost of the Liberty engine at more than $8,000, and was immediately regarded as too high by the American officials who first set a bogey price of $5,500 and later reduced this to $4,000 after the manufacture showed it to be about the proper price.

The Wright-Martin Co., it was stated, received $5,500 apiece for several thousand Hispano-Suiza engines it produced, this high figure being due to the royalties which had to be paid to Spain, as that country controls the Hispano-Suiza patents. The King of Spain, it was said, is the actual owner.

Discussing foreign engines and the American manufacturers' difficulties with them, Lieutenant Emmons said that when the specifications and drawings of the LeRhone engines were received they were almost unintelligible. They called, for example, for the use of mild steel when they should have specified chrome nickel, and the American authorities found it necessary to tear down an engine and analyze it to learn what metals were used in its manufacture before it was possible to make it.

There were 2500 LeRhone engines ordered, of which 1500 were delivered up to the signing of the armistice. These were made by the Union Switch Co., and were praised by the foreign chief engineer of the LeRhone factory abroad to be the best rotary engines he had ever seen.

Bugatti Production Difficult

The mission sent abroad by our authorities early in the war recommended the use of the Bugatti engine in our planes and insisted upon its use from overseas, partly because they did not know fully about the Liberty engine and also because they thought that the Bugatti might prove to be a very satisfactory machine.

The Bugatti engine sent to this country as a sample had never made over a 35 hr. test. It had suffered an accident in France and arrived in this country with a bent crankshaft. The American authorities, after straightening the shaft, found it necessary to redesign the engine before going into manufacture on it.

In discussing airplanes it was said that the DeHaviland-4 plane was the only combat plane in which this country had reached quantity production. One hundred sets of parts for the Handley-Page plane had been completed and shipped abroad. These were shipped in part sets because of the size of the planes and the consequent advisability of assembling them abroad. We were just entering into production on the USD9A, which is a substitute for the British DH9.

Three thousand Le Pere airplanes had been ordered from the Fisher Body Co. and Packard Motor Car Co., of which 25 were completed. Lieutenant Emmons paid high tribute to the Ford Motor Car Co., telling that they put 3 crews of men to work immediately when they received the orders for the Liberty engine cylinder, each crew experimenting to find the best production methods, and the company selected a method by which drawn steel tubes were cut in two by a special machine with a special die, heated, welded with cone-shape tops and then completed with bull-dozing machines.

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Army Fliers Map Air Lanes

WASHINGTON, Dec. 13—On their way from San Antonio to Houston, Tex., to-day, the four Army planes engaged in mapping a Southern air route across the continent had completed 1300 miles of reconnaissance from San Diego, Cal., when they landed at Kelly Field last evening.

The squadron left the Pacific Coast on Dec. 4 with five planes. One was lost in the fog near the mountains on the first day out and was forced to put back. The telegraph report received to-day at the Division of Military Aeronautics stated that the ground under the air route traveled between Alpine and Del Rio, Tex., was bad for landing fields, but from Del Rio east to San Antonio was excellent. The planes are photographing as they proceed East. The course they are flying to-day from San Antonio to Houston is 200 miles and it is expected that the flight will proceed from Houston straight to Gerstner Field, Lake Charles, La., and from there to Montgomery, Ala.

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43,000 Army Trucks Purchased

WASHINGTON, Dec. 18—The annual report of the Quartermaster-General of the Army shows that the following purchases and deliveries were made up to June 15, 1918:

Type	Total ordered plus on hand at beginning of to June 15, 1918	Total delivered to June 15, 1918
Trucks and chassis..	45,335	22,278
Trailers	1,213	696
Mobile machine shops	199	123
Passenger cars.....	8,369	8,277
Motorcycles	19,279	16,030
Side cars	17,899	14,636
Bicycles	13,796	12,314

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Army Planes for Air Mail

WASHINGTON, Dec. 15—The War Department turned over 100 DeHaviland-4 and twelve Handley-Page airplanes to the Postoffice Department to-day for air mail service. The DeHaviland planes can carry 400 lb. of mail and can be altered to carry 1200 lb. if necessary. The Handley-Page planes can carry more than a ton. The New York-Chicago airplane

route has been slightly changed, and Elizabeth, N. J., has been announced as the return terminal. Bellefonte, Pa., is the first regular stop, Leighton, Pa., the first emergency landing station and Cleveland the next stop, with an emergency station at Clarion, Pa. The last stop before Chicago is at Bryan, Ohio, where mail will be discharged and taken on.

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Ban Aerial Acrobatics Over Cities

WASHINGTON, Dec. 13—Aviators have been ordered to refrain hereafter from low flying and from acrobatics carried on in the vicinity of cities, towns and buildings. All acrobatic flying hereafter must be finished at an altitude not lower than 1500 ft. These orders are the result of increased flying accidents. Commanding officers have been instructed to take most stringent steps to carry out the order.

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Offers Prizes for Flights

WASHINGTON, Dec. 16—The Air Service Clubs Association, which is an association of officers and members of the United States Military Aviation Forces, will encourage tests in the air for both heavier-than-air and lighter-than-air machines and will award prizes for meritorious achievements. A committee will be appointed to pass upon these tests and flights.

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4045 Planes in Use Nov. 20

WASHINGTON, Dec. 16—On Nov. 20 there were 4045 pursuit, observation and bombing planes in use at the front by the American Expeditionary Forces, according to a letter from General Pershing to Secretary of War Newton D. Baker. Of this number 2675 were obtained from France and the remainder, 1370, from the United States. Up to Nov. 23, 1918, 8933 reserve military aviators had been trained in the United States. Total mechanics trained at American schools number 14,176.

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Wants Air Mail to Alaska

WASHINGTON, Dec. 13.—The extension of airplane mail service from this country to Alaska has been asked by Thomas Riggs, Jr., Governor of Alaska.

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Brazil to Have Air Service

WASHINGTON, Dec. 13—Brazil will shortly have an air mail service between its principal cities. The Government has granted concessions to a corporation allowing it to establish airplane mail service between the various capitals of the states of Brazil. Activities will comprise carrying of small parcels of mail, and, with further development of aviation, carrying of passengers. The number of trips, and the tariff will be regulated by the Government. All mail matter transported must be properly stamped and post-marked. In time of war the Government may take over the service.

P. H. Lyon Heads Jobbers; Manufacturers Now Members

CHICAGO, Dec. 18 — Automotive Equipment Association is the new name of the National Association of Automobile Accessory Jobbers, altered yesterday by constitutional amendment at the winter meeting of the organization. Another important constitutional amendment give to manufacturers full membership and places them on an equal footing with jobbers. Heretofore, manufacturers have been admitted only to associate membership.

Following the usual procedure, Vice-President Phil H. Lyon of the Chanslor & Lyon Co., San Francisco, was advanced from the post of vice-president to that of president. He succeeds S. F. Beech of the Motor Car Supply Co., Chicago. R. R. Englehart of the Seig Co., Davenport, Ia., advances from chairman of the board of directors to the vice-presidency and is succeeded by Robert A. Stranahan of the Champion Spark Plug Co., Toledo.

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Lame Start for Chicago-New York Air Mail Service

NEW YORK, Dec. 18—To-day marked the inauguration of the first long-distance airplane mail service in the United States when two planes departed almost at the same time from New York and Chicago to fly the 1000 miles between these centers. Neither plane reached its destination, which in each case was a sub-station approximately 200 miles from the starting point whence the mail was to have been relayed to another sub-station a similar distance from the first and thence to the end of the line.

Leon D. Smith, an army flier, started from Belmont Park, L. I., in a Liberty-engined De Haviland, but was forced to land at Bellefonte, Pa., 236 miles from the starting point; from here the mail was forwarded to Chicago by train. Delay at the Chicago end was caused by inability of the planes to reach that city from Defiance, Ohio. It was expected that a start would be made from Grant Park, Chicago, at 10 a.m., but this was impossible. Officials state that it will be several days before the service is operating smoothly.

Only first-class mail will be carried, the rate being 6 cents an ounce or fraction; parcels not exceeding 30 in. combined length and girth may be sent. It is expected that the service will cut the time between the two cities five to six hours.

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Ajax Issues $1,000,000 Stock

NEW YORK, Dec. 18—The Ajax Rubber Co. has issued new common stock in the amount of $1,000,000 to provide additional working capital for the company. Stockholders of record on Dec. 27 will be permitted to subscribe for the new issue of 20,000 shares of a par value of $50 each on the basis of 10 new shares for each 71 old shares of stock now held at $55 a share. The right to subscribe will expire Jan. 15. Including the new stock, the company will have outstanding 162,000 shares, bringing the outstanding stock from 7,100,000 to 8,100,000.

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Federal District Managers Meet

DETROIT, Dec. 18—District sales managers of the Federal Motor Truck Co. gathered here to-day for a sales convention which will continue on Thursday and Friday. The gathering will thresh out the sales policy of the concern, which is now getting back on a commercial basis after extended war work on Class B trucks and Federal trucks for the government.

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Recent Personnel Changes

A. C. Stebbins, president of the Lansing Co., and vice-president of the Capital National Bank of Lansing, Mich., has been appointed general manager of the Auto Body Co. of this city, succeeding H. E. Bradner, who withdrew from active management of the institution on account of ill health. He continues as president of the company.

K. R. Jacoby, who has been assistant to C. A. Earl, first vice-president of the Willys-Overland Co., Toledo, has been elected to a vice-presidency in charge of purchases of the company.

B. W. Knowles, formerly chief engineer and factory superintendent of the Electric Products Co., Cleveland, has been appointed chief engineer of the Baker R. & L. Co. of the same city.

C. C. Winningham, formerly advertising manager of the Hudson Motor Car Co., Detroit, and more recently engaged in the Department of Labor, Washington, has established an advertising agency in Detroit with headquarters in the Book Building. No one has been named to succeed Mr. Winningham.

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War Machinery Crumbling

WASHINGTON, Dec. 17—The war machinery here is fast crumbling. The War Industries Board, which is already to a great extent through, plans to turn over several more important departments to the Department of Commerce and Department of Interior on Jan. 1. Members of the Priorities Division have closed their desks and returned to their peace time duties. C. C. Hanch, head of the Automotive Section, is still continuing his work, which he thinks may be carried into the early Spring because of the difficulties arising from contract cancellations, but which, according to statements by Bernard M. Baruch, will probably be terminated with the beginning of the New Year, when contractors may have to deal directly with the War Department and not through the Section.

The Fuel Adminstration is preparing to turn over its departments on oil and gas to the Department of Interior and cease activities on Jan. 1. At the Bureau of Aircraft Production, where complete silence is maintained with regard to aircraft contract cancellations because it is feared that public announcement might have ill effects on the markets, activities are solely confined to this one phase of work and everyone is marking time awaiting Congress' decisions

as to further appropriations for airplane activity.

The War Trade Board is rapidly modifying the restrictions on exports and imports and is one of the few departments which are continuing actively. The Motor Vehicle Section of the Quartermaster Department, which has been in charge of procurement and purchase of motor vehicles, is preparing to end activities by February 1, 1919. By that time it is expected that all contracts will be in such shape that the work of this division can be transferred to the army.

The Motor Transport Corps is also marking time, awaiting the decision of Congress and the General Staff. It is expected that this corps will be permanent and will continue its activities of operating and maintaining army motor vehicles to some degree.

The Division of Military Aeronautics, waiting on Congress for its decisions, is engaged solely in the work of returning aero squadrons from the front and maintaining those few which will be kept up there. The preliminary training of cadet aviators has ceased. The Ordnance Department, Quartermaster Department, Engineer Corps, in fact all the various army divisions are discharging men and terminating their war duties as fast as possible. The important civilian heads are returning rapidly to their peace time work.

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Postoffice Bill Passes

WASHINGTON, Dec. 19—The Annual Postoffice Appropriation Bill, carrying $357,350,000, including $2,185,000 for air mail service and $1,000,000 for motor truck mail service, passed the House yesterday with but one important amendment, which cuts the air mail appropriation to $300,000 and requires the postoffice to use army aviators instead of organizing a new flying corps and stipulates the airplanes to be turned over to the postoffice by the War Department. It provides that the War Department shall supply more than 200 planes and more than 200 separate engines, and that these will be operated and maintained by the army under the control and direction of the Postmaster General. The bill now goes to the Senate.

The planes to be turned over by the War Department are specified in a section of the amendment as follows: "The Secretary of War is hereby directed to deliver immediately to the Postmaster General 100 De Haviland Fours, 100 Handley-Paige, 10 Glenn Martin day bombers; all planes to be completely assembled and with spare parts; 50 Hispano-Suiza 300 hp., 20 Hispano-Suiza 150 hp., 100 Liberty engines with spare parts, these to be out of any equipment the War Department has on hand or under construction; the War Department appropriation to be credited with the equipment turned over to the Postoffice Department."

The $1,000,000 appropriation for the operation of the motor truck mail service passed without change. The expenditure on any other appropriation for the improvement of highways was prohibited by striking out this clause of the bill.

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Truck Club Has Dealer Division

NEW YORK CITY, Dec. 18—The election of officers for 1919, the formation of a dealers' division and a strong talk by H. S. Quine of the Goodyear Tire & Rubber Co. were the features of the annual meeting of the Motor Truck Assn. of America held here to-night. The 1919 slate elected follows: Charles M. Geiger, president; John M. Wierk, L. E. Campbell and A. C. Bergmann, vice-presidents; Joseph Husson, secretary, and William P. Held, treasurer.

Lift Lid on Nearly All Exports

Practically Everything Can Now Be Sent to Allies—Ships for Trade Routes

WASHINGTON, Dec. 14—An almost unlimited export of commodities to the United Kingdom, France, Italy, Japan and other colonies was announced to-day by the War Trade Board, effective at once.

The commodities which will be allowed for export have not been specifically named, but include practically everything not on the conservation list, which has already been considerably reduced and which does not include, at this time, automotive products.

Each individual application for license, however, will be reviewed separately by the War Trade Board. At the same time the board will adopt a liberal policy of export for all countries for all materials except foodstuffs and with the sole exception of Germany, against which there will be no relaxation of blockade during the armistice period. The board expects also to open up completely export shipments to the neutral countries, including Norway, Holland, Sweden, Switzerland and Spain within a few days.

Ships with an aggregate carrying capacity of 800,000 tons have been designated to be turned over by the Quartermaster Department of the Army to the Shipping Board for return to trade routes, and this is expected to be one of the important factors in further reducing restrictions against export. It is expected that the ships will be used principally for trade with South and Central America.

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W. T. B. to Consider Import Applications

WASHINGTON, Dec. 16—The War Trade Board will now consider applications to import platinum, antimony, tin and tin concentrates from Russia, including Siberia and Finland. It will also give consideration to the importation of other commodities, but will give preference to those named above and to seeds, roots and skins. A limited amount of cargo space is now available for shipments from Vladivostok to points on the Pacific Coast of the United States.

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Spanish Duty on Cars Changed

WASHINGTON, Dec. 15—Passenger automobiles which have heretofore been dutiable on gross weight in shipments to Spain are now dutiable on the basis of net weight, according to a commerce report. It is expected that this new plan will remove the discrimination which has existed by reason of the fact that automobiles might be unpacked in the free port of Cadiz and entered on the net weight, whereas duty was charged on the gross weight in other ports. It was reported that a number of automobile manufacturing companies had established warehouses in the free port of Cadiz to take advantage of this condition. Under the new ruling nothing will be gained by such procedure, and the Consul General reports that the dismounting of automobiles in the free port of Cadiz is no longer permitted.

The same order provides that forgings or castings for the construction of automobiles imported in the condition in which they left the forge or foundry shall be dutiable as manufactures of forged or cast metal according to the weight. Other parts, whether finished or partly finished, are to be classed as automobile parts. On leaving free ports automobile parts will be subject to duty proportionately as automobiles.

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Articles Removed from Export List

WASHINGTON, Dec. 15—The following articles are included among the commodities which have been removed from the export conservation list, according to an announcement made to-day by the War Trade Board:

Alloys, as follows: Cadmium; nickel; titanium; uranium; zirconium.
Aluminum, all articles containing 10 per cent or more (in weight) of metallic aluminum.
Antimony; articles containing antimony; ore.
Brass, and all articles containing 10 per cent or more (in weight) of brass.
Brass pipe.
Brass plates.
Brass sheets.
Brass tubes.
Brass wire.
Cadmium, as follows: Alloys; metal.
Chromium ore, and any metal or ferroalloy thereof.
Cobalt ore, and any metal or ferroalloy thereof.
Copper, as follows: All articles containing 10 per cent or more (in weight) of copper; pipe; plates; rods; sheets; tools; scrap; tubes; wire.
Ferroalloys, as follows: Ferrocerium; ferrochrome; ferrocobalt; ferromanganese; ferromolybdenum; ferrotitanium; ferrotungsten; ferrouranium; ferrovanadium; ferrozirconium.
Lead, as follows: Pipe; sheet.
Machines, as follows: Oil-well drilling, and accessories.
Manganese ore and any metal or ferroalloy thereof.
Manganese oxide.
Nickel, all articles containing 10 per cent or more (in weight) of nickel.
Nickel alloys.
Ore, as follows: Antimony; chromium and any metal or ferroalloy thereof; cobalt and any metal or ferroalloy thereof; manganese and any metal or ferroalloy thereof; radium; strontium; titanium; tungsten and any metal or ferroalloy thereof; uranium; zirconium.
Pyrites.
Titanium and its compounds.
Titanium ores.
Uranium, as follows: Alloys; ores.
Vanadium.
Zinc or spelter.
Zirconium, as follows: Alloys; metals; ores or concentrates.
Carbon electrodes.
Cells, electrolytic.
Electrodes, as follows: Carbon; graphite (plumbago).
Electrolytic cells.
Generators, suitable for searchlights.
Radio and wireless apparatus and all accessories.

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New York-Valparaiso Boat Service Resumed

WASHNGTON, Dec. 15—Direct passenger service by boat has been resumed between New York and Valparaiso, following orders by the United States Shipping Board for the release of the tonnage. It is expected that, however, will only be given to immediate commercial needs for the time being.

Rubber Imports Still Decline

November Strikes New Low Level—Total for 11 Months Far Behind Last Year

NEW YORK, Dec. 16—Importations of crude rubber have been steadily declining during the past 11 months and during the month of November reached a new low level when the total tonnage to come in amounted to only 3363 tons. As compared with November, 1917, when 13,611 tons were imported, this is a loss of 10,248 tons. Similarly, there was a big drop in the figures for November this year as compared with October, the loss being 6146 tons.

The total imports for the 11 months to date are approximately one month's supply below those for the same period last year, taking an average month's imports as a guide. During this period in 1917 imports totaled 158,906 tons as compared with 144,003 tons for the first 11 months of 1918. The loss in this case is 15,903 tons. Following are the statistics as compiled by the Rubber Association of America:

	1917 Tons	1918 Tons
January	12,788	16,084
February	10,162	13,108
March	18,624	17,161
April	13,000	12,703
May	18,411	16,288
June	15,096	24,124
July	17,290	16,092
August	17,290	10,421
September	13,664	5,151
October	8,970	9,509
November	13,611	3,363
Total	158,906	144,003

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Restrictions on Import of Rubber Removed

WASHINGTON, Dec. 16—All restrictions on the quantity of crude rubber imports from overseas have been removed, according to an announcement made here to-day by the War Trade Board. Applications for licenses to import crude rubber will now be considered without limit as to quantity. The War Trade Board also announces that it withdraws the Government option price and will require no further undertakings relative to maximum values. It will continue to require guarantees similar to those asked in the past. Modification of rubber imports, however, will not allow importation of rubber from any other than the country of origin until after Feb. 13, 1919.

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Re-Exports of Rubber Decline

WASHINGTON, Dec. 15—Re-exports of raw rubber, including waste and reclaimed, declined in quantity from 81,775,700 lb. in the first 9 months of 1916 and 101,749,400 lb. in the first 9 months of 1917 to 31,209,900 lb. for the first 9 months of 1918, and the value fell from $57,985,880 in the first named period and $70,369,089 in 1917 to $18,396,514 in 1918. Imports of raw rubber in England, including waste and reclaimed, totalled $84,241,355 for the first 9 months of 1916, $91,893,137 for the first 9 months of 1917, and decreased to $44,856,792 for the first 9 months of 1918, while the quantities decreased to 79,221,400 lb. in 1918 as compared with 148,720,800 lb. in 1917 and 128,141,000 lb. in 1916.

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Great Reduction in Rubber Exports from London to the U. S.

WASHINGTON, Dec. 15—In the 10 months ending October, 1918, rubber exports from London to the United States totalled $3,743,639 as against $39,770,603 for the same period of the year previous, according to a Commerce Report.

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Exports to Federated Malay States

WASHINGTON, Dec. 16—Automobiles, tractors and parts and accessories can now be exported to the Straits Settlements and the Federated Malay States. The restrictions against these exports which have been in effect since May 16, 1917, have been revoked, according to a cablegram received here from the American consul-general at Singapore.

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Preference for Certain South American Exports

WASHINGTON, Dec. 15—Ocean shipments for exports to the east coast of South America will be controlled under a preference arrangement by the War Trade Board in co-operation with the Shipping Control Committee of the United States Shipping Board. "Shipping preference No. 1" will be awarded in exceptional cases when shipment is of the utmost importance and all shipments given this preference will have priority over all other shipments. In order to expedite the completion of export contracts entered into prior to the recent relaxation of the granting of licenses, the Shipping Control Committee will give priority in loading to shipments covered by export licenses dated prior to Nov. 12, 1918.

It will not be necessary for the holders of licenses to make further application or secure any endorsement to get this priority. Holders of licenses already issued and applicants for new licenses who believe that they are entitled to "shipping preference No. 1" can file a request with the War Trade Board.

Exporters should expect, says the War Trade Board, under present shipping conditions, that there may be considerable delay in exporting commodities licensed subsequent to Dec. 8, 1918, and not covered by "shipping preference No. 1."

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Making of Contracts Discontinued

WASHINGTON, Dec. 16—Making of contracts by the various War Department divisions for the purpose of clearing up stocks held on hand by manufacturers has been stopped by an official order issued late last week, and for the present no further contracts on war materials are being made.

M. T. C. Will Keep Its Vehicles

No Sale of Cars or Trucks—Taxi Plan of Pooling Transportation Successful

WASHINGTON, Dec. 13—All passenger cars and standardized trucks now in the possession of the Motor Transport Corps in this country will be retained by the Army, according to an official announcement made here to-day. Non-standardized trucks and Nash Quad trucks will be turned over to the Post Office Department to fill its requirements, or, states the announcement, possibly, in the case of the Nash trucks these will be put on the market for sale. Rumors that the Army would sell large numbers of Dodge, Cadillac and other passenger cars at low prices are erroneous. None of this equipment will be sold.

$200,000 Saved a Month

In its monthly report the Army Motor Service, which is the taxi service for the Army in Washington and elsewhere, shows a saving in expense of operation of passenger vehicles in the Army amounting to $200,000 for November as compared with the expenses of October.

Prior to Nov. 1 cars for the use of the Army were assigned to individuals or to various departments. Now, with the exception of 33 cars assigned to heads of departments, all passenger equipment of the District of Columbia is pooled and motor busses are operated on a sort of taxi system between the various principal buildings.

These busses and the passenger cars are for official use only. Thirteen principal stations have been established for them and telephone service can call these cars for official business similarly to the usual call for taxicabs.

In the month of November 14,899 trips were made in the District of Columbia covering 106,608 miles. Prior to Nov. 1 the average number of cars in operation per day was 257 passenger cars and 2 busses. Since Nov. 1 141 passenger cars and 11 busses have operated daily.

The taxi system has been so successful that it will be inaugurated at once in New York, Philadelphia, Chicago, St. Louis and Atlanta.

Trucks in U. S. Also Pooled

The motor trucks used by the Army in the United States have also been pooled and are now operated for the benefit of the Army as a whole under the Motor Transport Corps management. The reduction of expense on trucks has not yet been reported, but it will be far greater than that on passenger service.

The number of garages for Army vehicles in Washington has been reduced by means of the taxi system and pooling from 16 to 8. Eventually all cars under the corps will be driven by enlisted men, thereby reducing the wage account and insuring better care for the equipment.

Men of the Industry

Changes in Personnel and Position

Elliot C. Morse Returns to New York

WASHINGTON, Dec. 16—Elliot C. Morse, formerly vice-president of the Chalmers Motor Car Co., and the past year in Washington as the general representative of the Willys-Overland Co. in Government contract matters, is leaving Washington to head the export work for the Willys-Overland interests in New York City.

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A. C. Harrington, vice-president of sales of the Packard Motor Car Co. of New York, has resigned to handle the national truck accounts for the Packard factory. The new office of manager of distribution, created to fill Mr. Harrington's place, will be held by H. Bertram Lewis, advertising manager. In addition to the direction of carriage, truck, used vehicle, custom body and accessories sales, Mr. Lewis will supervise the advertising and motor transportation departments. Charles B. Morse, manager of direct advertising, and William Carl Chapman, publicity manager, will handle the company's advertising under his supervision.

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T. T. Fauntleroy has been appointed sales engineer for the Lakewood Engineering Co., Cleveland, with headquarters at 1034 Widener Bldg., Philadelphia. He was formerly New York branch manager for the Gurney Ball Bearing Co. and latterly has been manager of the central sales district for the same company.

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Prescott C. Ritchie, Western representative of the Westinghouse Automobile Equipment Department, moved his headquarters from Indianapolis to the Conway Building, Chicago.

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Captain Edward Vail, who left the Waltham Watch Co. to follow the flag, has been appointed on an adjustment board and probably will have his headquarters in New York. He expects to be released from service in February.

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Herbert C. Severance, secretary and sales manager of the Racine Rubber Co., Racine, Wis., and one of the best known figures in the American tire and rubber industry, died at his home in Racine on Nov. 23. Mr. Severance was born in Cambridge, Mass., on Oct. 28, 1878.

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T. J. Turk, formerly connected with the Kissel Motor Car Co. and the General Motors Truck Co., has resigned his position as assistant general manager of the Inter-State Motor Co.

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Wants American Agencies

NEW YORK, Dec. 15—J. R. Bournigal, P. G., Puerto Plata, Dominican Republic, has become affiliated with a company styled Ecos Del Norte, which at present is operating as a manufacturer's representative. The firm is anxious to affiliate itself with manufacturers of American specialties, with the object of representing such manufacturers.

British Representative Coming

NEW YORK CITY, Dec. 15—Capt. A. S. F. Morris, R. A. F., managing director of Morris, Russell & Co., London, England, is expected to arrive in New York shortly, and will make his headquarters at the New York office of the company, 14-16 Church Street. He will be here in the interest of this firm, which is looking for representation for car accessories and parts.

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England Sees Development of Commercial Aviation

(*Continued from page* 1064)

The increased use of gasoline has already led to suggestions for greater production of petroleum and the possible use of other grades of fuel. The war has impressed on Great Britain in many ways the importance of gasoline in the entire transportation system of the nation and the development of fuels is certain to receive much attention.

Nothing definite has been done in the laying out of aerial highways further than that it is recognized that there will be main routes such as London to Edinburgh; London to Glasgow; London to Paris; London to Dublin; London to Russia; London to the Riviera; London to Africa, and other routes pointing toward India and Australia.

Laws governing aerial transportation and aerial navigation have already been considered and conferences will soon be called to deal with these and kindred questions. There must be settled the question of the right of any nation to control of the air above its land and also above its 3-mile water limit, which zone of air might for convenience be called the terrestrial air limit.

The conclusion is that a 3-mile limit for air surrounding the boundaries of a country along the water will not suffice and that a conference will be necessary to determine the best limit.

A host of problems will arise in connection with international flying, such as passports, customs regulations, signals, aerial traffic regulations, aerial trespassing, and injury to persons and property due to aerial navigation.

While aviation has been brought to its present success largely through government requirements in the war, sentiment is fairly general that commercial aviation should be as free as possible from government control and that the great experiments in business flying must be made by individuals and individual corporations. It is not incumbent upon the state to carry on such work. The state must take up very early all questions relating to necessary legislation.

Don E. Bailey Dies

SAN FRANCISCO, Dec. 16—Don E. Bailey, for 10 years intimately connected with the Bailey-Drake Co., which he founded, died Nov. 29 from pneumonia, following an attack of influenza. Mr. Bailey organized the Bailey Specialty Co. in San Francisco and this was later changed to the Don E. Bailey Co. In 1914 Mr. Drake, then general sales manager of the Remington Arms Union Metallic Cartridge Co., resigned that position to enter the firm, when the name was changed to Bailey-Drake Co. At present the company has branches in San Francisco, Seattle and Kansas City, the principal headquarters having recently been moved from San Francisco to Chicago.

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Prominent Maine Dealer Dies

PORTLAND, Dec. 15 — Albert M. Speare, Jr., one of the most widely known automobile men in New England, and president of the Portland Automobile Dealers' Association, died here yesterday after a brief illness. He had handled some of the best known cars on the market, and he was the distributer of Dodge Brothers cars since that line was introduced into Maine.

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Harry Biggs Appointed General Sales Manager of Studebaker

CHICAGO, Dec. 15—Harry Biggs has been appointed general sales manager of the Studebaker Corp., South Bend. He was formerly Chicago manager for the Frank Seaman Advertising Agency.

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McAdoo Leases Houk Home

LOS ANGELES, Dec. 16—W. G. McAdoo, former secretary of the treasury and director of railroads, has leased the Los Angeles home of the late George W. Houk. He will move in Jan. 1 and occupy the premises for three months.

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Turner Goes to Buick

NEW YORK, Dec. 15—Frank Turner, formerly comptroller of the Du Pont Co., has been appointed comptroller of the Buick division of the General Motors Co., with headquarters at Flint, Mich. J. B. Broad is appointed to the vacant office of the Du Pont Co.

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Tractor Show in Milwaukee

MILWAUKEE, Dec. 14—One of the largest and most comprehensive expositions of tractors and power farm machinery ever staged under one roof was that which accompanied the thirteenth annual convention of the Wisconsin Implement Dealers' Association at Milwaukee, Dec. 10, 11 and 12. The entire Auditorium was pressed into service to accommodate the display, the general sessions, and sectional meetings. The machinery exposition contained more than 350 distinct exhibits, from giant tractors to automatic milkers. Farm lighting systems were an interesting feature.

AUTOMOTIVE MATERIALS MARKETS

Materials Market Prices

Acids:
Muriatic, lb. ..... .02 -.03
Phosphoric (85%)... .35 -.39
Sulphuric (60), lb.. .006

Aluminum:
Ingot, lb. ..... .33
Sheets (18 gage or more), lb. ..... .42

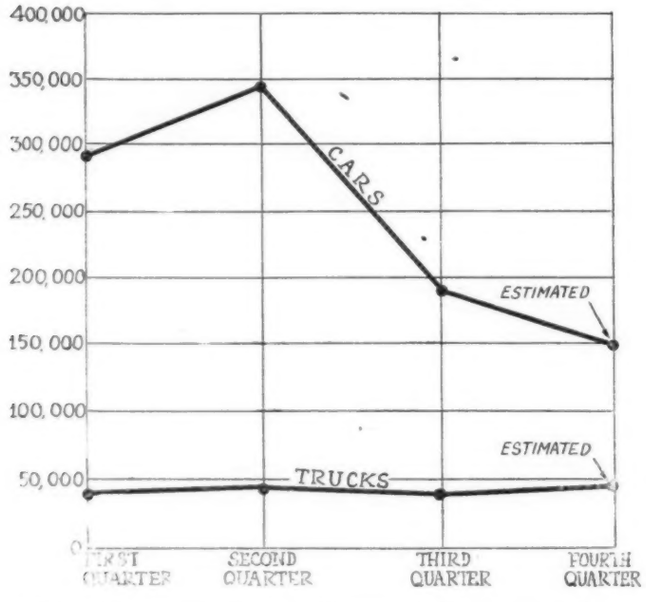
Antimony, lb. ..... .13¾-.13⅞

Burlap:
8 oz., yd..... .17¼-.17½
10½ oz., yd..... .21½-.22

Copper:
Elec., lb. ..... .26
Lake, lb. ..... .26

Fabric, Tire (17¼ oz.):
Sea Is., combed, lb.1.65-1.70
Egypt, combed, lb.1.25-1.35
Egypt, carded, lb.1.20-1.30
Peelers, combed, lb.1.05-1.20
Peelers, carded, lb. .95-1.05

Fibre (⅛ in. sheet base), lb. ..... .50



The effect of wartime conditions on the automotive industry may be gaged by taking the figures shown on this chart in relation to the 1917 *production of* 1,718,000 *cars and* 160,000 *trucks*

Graphite:
Ceylon, lb. ..... .09 -.22
Madagascar, lb. ... .10 -.15
Mexico, lb. ..... .03¾

Lead, lb. ..... .06¾-.07¼

Leather:
Hides, lb. ..... .18 -.35¼

Nickel, lb. ..... .40

Oil:
Gasoline:
Auto, gal. ..... .24½
68 to 70 gal..... .30½
Lard:
Prime City, gal..2.30-2.35
Ex. No. 1, gal...1.62
Linseed, gal. 1.63-1.65
Menhaden (Brown), gal. 1.35-1.36
Petroleum (crude),
Kansas, bbl. 2.25
Pennsylv'a, bbl. 4.00

Rubber:
Ceylon:
First latex pale crepe, lb. 56
Brown, crepe, thin, clear, lb. ..... .52
Smoked, ribbed sheets, lb. .... .54½
Para:
Up River, fine, lb. .63½
Up River, coarse, lb. ..... .37½
Island, fine, lb... .54
Shellac (orange), lb.. .74 -.75
Spelter ..... .08½-.08¾
Steel:
Angle beams and channels, lb. .... .03
Automobile sheet (see sp. table).
Cold rolled, lb..... .06½
Hot rolled, lb..... .03½
Tin ..... .71
Tungsten, lb. 2.00-2.50
Waste (cotton), lb... .12¾-.17

AUTOMOBILE SHEET PRICES

(Based on No. 22 Gage. Other gages at usual differentials)

	Primes only per 100 lbs.	Primes when seconds up to 15 per cent are taken per 100 lbs.
Automobile body stock.....	$5.95	$5.85
Automobile body stock, deep stamping	6.20	6.10
Automobile body stock, extra deep stamping	6.45	6.35
Hood, flat, fender, door and apron, or splash guard stock	6.05	5.95
Crown fender, cowl and radiator casing, extra deep stamping.....	6.55	6.45
Crown fender, cowl and radiator casing, deep stamping	6.30	6.20

Automobile Sheet Extras for Extreme Widths:
Nos. 17 and 18 over 36 in. to 44 in., 10c. per 100 lb.
Nos. 19 and 21 over 36 in. to 44 in., 30c. per 100 lb.
Nos. 22 to 24 over 26 in. to 40 in., 40c. per 100 lb.
Nos. 22 to 24 over 40 in. to 44 in., 80c. per 100 lb.

Black Sheet Extras to Apply to Narrow Widths:
Oiling, 10c. per 100 lb.
Patent leveling, 25c. per 100 lb.
Resquaring, 5 per cent of gage price after quality, finish and size extras have been added.

Seconds 10 per cent less than the invoice Pittsburgh price for corresponding primes.

Automobile Securities on the Chicago Exchange at Close Dec. 14

	Bid	Asked	Net Ch'ge
Auto Body Company.....	5	8	—2
Briscoe Motor Car, com.....	11	..	..
Briscoe Motor Car, pfd.....	40	55	..
Chandler Motor Car.....108½		110½	+4½
Chevrolet Motor Car.....144		146	..
Cole Motor Car Co.....	90	105	..
Continental Motors, com...	8¼	8¾	— ¼
Continental Motors, pfd....	92	96	..
Edmunds & Jones, com....	20	22	+2
Edmunds & Jones, pfd.....	75	90	..
Electric Storage Bat.....	50	54	..
Federal Motor Truck.....	31	35	..
Fisher Body Co., com.....	35½	37½	— ½
Fisher Body Co., pfd.....	92	93	— ½
Ford Motor of Canada.....225		235	+10
General Motors, com.....125½		126½	—1
General Motors, pfd.....	80⅝	82⅝	+ ⅜
Hupp Motor Car, com.....	4½	5	..
Hupp Motor Car, pfd.....	81	85	..
Kelsey Wheel Co., com.....	28	30	..
Kelsey Wheel Co., pfd.....	85	90	..
Manhattan Electric S., com.	..	48	..
Maxwell Motor, com.....	28½	29½	..
Maxwell Motor, 1st pfd.....	52	53	+ ½
Maxwell Motor, 2d pfd....	20⅛	21⅛	— ⅝
McCord Mfg., com.....	30	35	..
McCord Mfg., pfd.....	90	95	..
Mitchell Motor Co.....	25	35	—5

	Bid	Asked	Net Ch'ge
Motor Products Corp.....	40	..	..
Nash Motors Co., com.....175		200	+25
Nash Motors Co., pfd.....	87	92	+2
National Motor Co.....	9	12½	..
Packard Motor Car, com....105		115	—10
Packard Motor Car, pfd....	97½	..	+2½
Paige-Detroit Motor, com...	23	25	—4
Paige-Detroit Motor, pfd...	8¾	9¾	..
Peerless Motor Truck.....	17	20	+3
Pierce-Arrow Mot. Car, com.	43½	44½	..
Pierce-Arrow Mot. Car, pfd.103½		104	+1⅜
Premier Motor Corp., com..	4	..	..
Premier Motor Corp., pfd...	..	75	..
Prudden Wheel Company..	15½	17½	+ ½
Reo Motor Car Co.....	21¾	22¾	— ¾
Republic Motor Truck, com.	35½	38	+2½
Republic Motor Truck, pfd..	89	92	+1
Saxon Motor Car, com....	8¼	10¼	+ ½
Scripps-Booth Corp.	21	25	..
Stewart Warner Speed. Corp.	77	79	+2
Stromberg Carburetor Co...	31	36	+7
Studebaker Corp., com.....	51⅝	52⅝	—1
Studebaker Corp., pfd.....	93	97	+ ¾
Stutz Motor Car Co.....	52	54	+5¾
United Motors Corp.....	33½	35½	+ ⅞
*White Motor Co.....	47	48	+ ½
Willys-Overland, com.	24⅞	25⅞	— ⅝
Willys-Overland, pfd.	88	89	+1

Rubber Stocks

	Bid	Asked	Net Ch'ge
Ajax Rubber Co.....	66	68	+5
Firestone T. & R., com.....125		130	..
Firestone T. & R., pfd.....	99	101	..
Fisk Rubber Co., com.....	60	65	..
Fisk Rubber, 1st pfd.....	97	103	..
Fisk Rubber, 2d pfd.....	80	84	+1
Fisk Rubber, 1st pfd. conv..	90	97	..
Goodrich, B. F., com.....	56	57	+4
Goodrich, B. F., pfd.....104		106	+3
Goodyear T. & R., com.....210		217	—15
Goodyear T. & R., 1st pfd..104		106	+2
Goodyear T. & R., 2d pfd...100		101	—1
Kelly-Springfield, com.	64	65	+8
Kelly-Springfield, pfd.	80	91	—8
Lee Tire & Rubber Co.....	22	24	+2
Marathon Tire & Rubber... ..		55	..
Miller Rubber Co., com.....142		148	..
Miller Rubber Co., pfd.....	96	98	..
Rubber Products Co..... ..		101	..
Portage Rubber Co., com...145		149	..
Swinehart T. & R. Co.....	50	60	..
U. S. Rubber Co., com.....	74	75	+12
*U. S. Rubber Co., pfd....108		108⅞	+3½

*Ex Dividend.

Current News of Factories

Notes of New Plants—Old Ones Enlarged

Holt Back on Peace Work

PEORIA, Dec. 15—The Holt Mfg. Co., which has been engaged for the past 18 months in manufacturing tractors for the war department to be used in Europe, has returned to a peace basis, all war contracts having been cancelled. For a time, three shifts of employees, working 8 hours each, were required to keep pace with the orders. The company has employed 6000 men the greater part of the year.

From now on, the plant will be devoted exclusively to the manufacture of tractors for agricultural and commercial purposes. Camp Herring, the War Department's instruction school for the training of tractor drivers and mechanics, operated adjoining the Holt plant, has been closed and the barracks and other buildings will be dismantled. As rapidly as a trainload of tractors was shipped, a squad of drivers and mechanics, sufficient to take care of each machine, was sent along. In all 5000 tractor drivers and mechanics were trained at Camp Herring, and these men are now returning from Europe and, in many instances, will be seeking employment from tractor owners. Their thorough training will render them invaluable to farmers who favor tractors.

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Canadian Hayes to Make Axles

CHATHAM, ONT., Dec. 16—It is stated that the Hayes Wheel Co. will shortly begin the manufacture of complete axles in addition to its present line of wheels, hubs, rims, etc. The company has been handling a large shell contract for the Canadian Government in a special plant. The plant was laid out and equipped with a view to converting it for the construction of passenger car axles and the present plan is to convert the plant as quickly as possible.

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Killen-Strait on the Block

APPLETON, Wis., Dec. 14—The plant and other assets of the Killen-Strait Mfg. Co., Appleton, Wis., manufacturer of tractors and gas engines, were sold at receiver's sale on Dec. 12 to A. W. Priest, an Appleton manufacturer, who intends to use the plant for the production of pumps, blowers and similar mechanical devices and discontinue the tractor line. The purchase price is $22,000, which requires confirmation by the Circuit Court on Dec. 23. The Killen-Strait Co. was placed in the hands of a receiver early in June this year.

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Happy Farmer Increases Capital

BUCYRUS, OHIO, Dec. 16—The Ohio Happy Farmer Tractor Co. has increased its capitalization from $20,000 to $40,000. The new issue consists of 200 shares of common stock of a par value of $100.

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Four-Wheel La Crosse Tractor

LA CROSSE, WIS., Dec. 16—The La Crosse Tractor Co. is shortly to enter the market with a four-wheel type of farm tractor. This will be known as model G, and though it differs considerably from its predecessor, model F, it is not entirely a new model, but is essentially a modification of the former, in which two front wheels take the place of the single front wheel used heretofore.

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Detroit Office for General Steel

MILWAUKEE, Dec. 15—The General Steel Co., manufacturer of die blocks, piston rods and tool steel, will hereafter be represented in the Michigan district by D. J. Crowley, 823 Dime Bank Building, Detroit.

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$7,628,783 for Army Cars

WASHINGTON, Dec. 14—A statement of expenditures in the annual report of the Chief of Ordnance shows that a total of $7,628,783.67 was expended for the fiscal year of 1918 for Army motor cars.

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The Use of Measuring Wires

(*Continued from page* 1056)

the first or simple formula for 60-deg. threads rarely equal 0.0001 in., and then only when the helix angle is large.

It has been claimed that measurements of effective diameter made by the three-wire method result in values which are smaller than those secured by other means, such as by thread micrometers. This contention is probably justified in some cases and may be due to insufficient care in making measurements. It is important in making measurements that as little pressure as possible be applied on the wires with the measuring micrometers. Since the wires rest in a V-thread, a given pressure exerted on the top of the wire will have a magnified effort of distorting the wire where the contact is made on the sides of the thread. This will result in the measurement over the wires being less than it should be. Furthermore, if the wire is standardized under a light pressure and then used with a larger pressure the diameter of the wire which is substituted in the formula for computing the effective diameter will be larger than it should be. This difference is multiplied by the factor 3 in the formula and the tendency is to make the result small. Excess pressure is often placed upon the wires during the measurement by use of ratchet or friction stops on micrometers; or by an unskilled operator, and sometimes on account of the arrangement of the wires and the screw thread when the measurements are taken. It is poor practice to support the screw being measured on two wires which are in turn supported on a horizontal surface, for if the screw is of large diameter the weight of the screw causes a distortion of the wires and interferes with the measurement.

Studebaker to Double Capacity

SOUTH BEND, Dec. 16—According to present plans of the Studebaker Corp., the South Bend plant will add 7000 employees during the next year and double the present capacity of the factory. The plant will be in complete operation by the summer of 1920. The new plant will have a capacity of 100,000 finished automobiles annually, and with the 60,000 annual output of its combined Detroit plants, the corporation will more than double its capacity in the manufacture of cars.

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$15,000,000 Studebaker Notes Issued

NEW YORK, Dec. 16—The Studebaker Corp. has completed the financing plan which has been on the boards for several weeks and this takes the form of an issue of $15,000,000 in 7 per cent serial notes maturing in various amounts from Jan. 1, 1921, to Jan. 1, 1929.

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"The Automobile After the War"

(*Continued from page* 1058)

a publicity campaign appropriate to the section of the country and the kind of purchasers to be reached; keeping a large stock of parts of different cars and models ready to be delivered to owners; a large stock of accessories and an up-to-date shop sufficiently well equipped to carry on even very important repairs; maintaining a large number of show cars by means of which it would be possible to demonstrate to the prospective buyer the dominant qualities and advantages of each model. As to the methods of payment, cash or different installment plans should be offered to the buyer. This is an indispensable condition of popularizing the automobile among small manufacturers, doctors, veterinary surgeons, etc. In this connection Mr. Cote mentions the "automobile bank" which was organized for this purpose but failed. Here is a field in which financiers can take the initiative and start a financial organization in which the manufacturers could well afford to participate.

Branch Office vs. Direct Agency

Mr. Cote is in favor of direct agencies and thinks that this is the best method for both the buyer and the manufacturer. Further, he thinks that these should be located throughout France and its colonies. On the other hand, he believes it would be a serious mistake not to take advantage of independent organizations which already possess a number of garages and repairshops. These would prove valuable auxiliaries to the automobile industry, and there is no reason why sufficient guarantees could not be offered to such organizations to include them in a general association as described above, and having a purely commercial purpose.

Mr. Cote is very much in favor of combining and centralizing in an independent and democratic way manufacturers and sales organizations to lead the automobile industry to triumphant success. This success can be attained by co-operative but not by isolated efforts.

Calendar

ENGINEERING

S. A. E. Meetings 1919

Jan. 8—Minneapolis Section, S. A. E.—Hotel Radisson. "Governors for Tractors and Truck Engines."

Feb. 4-6—New York. Winter Meeting. Society of Automotive Engineers, Engineering Societies' Building.

Feb. 5—Minneapolis Section, S. A. E. — Hotel Radisson. "Radiator Cooling Fans."

March 5 — Minneapolis Section, S. A. E.—Hotel Radisson. "Tractor Service and Sales."

April 2—Minneapolis Section, S. A. E. — Hotel Radisson. "Implements Designed for Tractor Belt Power and Their Characteristics."

MOTOR SHOWS

Dec. 25-Jan. 1—Los Angeles, Cal. Automotive Exposition.

January — Detroit, Mich. Detroit Automobile Dealers' Assn. H. H. Shuart, Manager.

January or February—Milwaukee, Wis. Milwaukee Auto Trade Assn. Bart J. Ruddle, Manager.

Jan. 24-30 — Milwaukee, Wis. Eleventh Annual, Milwaukee Automobile Dealers, Inc., Auditorium. Bart J. Ruddle, Manager.

Jan. 25-Feb. 1—Chicago. Passenger cars, Coliseum.

February—Grand Rapids, Mich. Grand Rapids Automobile Business Assn. E. T. Conlon, Manager.

Feb. 1-15—New York. Automobile Dealers' Assn. Charles A. Stewart, Manager, Hotel Woodward, Broadway and 55th St.

Feb. 3-5 — Chicago. Trucks, Coliseum.

Feb. 15 - 22 — Louisville, Ky. Louisville Auto Dealers' Assn.

Feb. 15-22—Newark, N. J. N. J. Auto Exhibition Co. Calude Holgate, Manager.

Feb. 15-22—Minneapolis, Minn. Northwestern Automotive Exposition, Overland Building.

Feb. 15-22—Minneapolis, Minn. Minneapolis Auto Trade Assn. Walter B. Wilmot, Manager.

Feb. 17-22—Des Moines, Iowa. Tenth Annual, Des Moines Automobile Dealers' Assn. C. G. Van Vliet, Manager.

Feb. 15-22—Albany, N. Y. Albany Automobile Dealers' Assn. State Armory.

Feb. 17-24 — Passenger Cars; Feb. 24-27, Trucks—South Bethlehem, Pa. Lehigh Valley Auto Shows Co. J. L. Elliott, Manager.

Feb. 24-March 1—Kansas City, Mo.—Kansas City Motor Dealers' Assn. E. E. Peake, Manager.

March — Great Falls, Mont.—Montana Automobile Distributers' Assn.

March—Philadelphia, Pa. Philadelphia Automobile Trade Assn. Passenger cars.

March—Motor Truck Assn. Trucks.

Mar. 3-8—Columbus, O. Columbus Automobile Show Co., Memorial Building. W. W. Freeman, Manager.

March 3-8—Buffalo, N. Y. Buffalo Automobile Dealers' Assn.

March 1-10—San Francisco, Cal. Motor Car Dealers' Assn. G. A. Wahlgreen, Manager.

March 10-15—Syracuse, N. Y. Syracuse Automobile Dealers' Assn. Harry T. Gardner, Manager.

Second or third week March—St. Louis, Mo. St. Louis Auto Mfrs. & Dealers' Assn. Robert E. Lee, Manager.

March 15-22 — Boston, Mass. Boston Automobile Dealers' Assn. Chester I. Campbell, Manager.

March 22-29, Passenger Cars; April 1-5, Trucks—Brooklyn. Brooklyn Motor Vehicle Dealers' Assn. I. C. Kirkham, Manager.

Third week March—Trenton, N. J. Trenton Auto Trade Assn. John L. Brock, Manager.

Probably March—Chicago. Chicago Automobile Trade Assn.

March—Philadelphia. Philadelphia Automobile Auto Trade Assn. A. L. Maltby, Manager.

March—Pittsburgh. Automobile Dealers' Assn. of Pittsburgh. John J. Bell, Manager.

March—Syracuse, N. Y. Syracuse Automobile Dealers' Assn. Harry T. Gardner manager.

March—Utica, N. Y. Utica Motor Dealers' Assn. W. W. Garabrant, Manager.

Late March or early April—Cleveland, Ohio. Cleveland Auto Show Co. Fred H. Caley, Manager.

April 5-12—Montreal, Can.—National Motor Show of Eastern Canada, Victoria Rink. T. C. Kirby, Manager.

Not decided—Bridgeport, Conn. Auspices of City Battalion. B. B. Steiber, Manager.

Not decided — Harrisburg, Pa. Harrisburg Motor Dealers' Assn. J. Clyde Myton, Manager.

Not decided — Hartford, Conn. Hartford Automobile Dealers' Assn.

Not decided—Indianapolis, Ind. Indianapolis Auto Trade Assn. John B. Orman, Manager.

Not decided—Kansas City, Mo. Kansas City Motor Dealers' Assn. E. E. Peake, Manager.

TRACTOR SHOWS

Feb. 10-15 — Kansas City, Mo. Fourth Annual Tractor Show. Sweeney Building. Kansas City Tractor Club Guy H. Hall, Sec.

Feb. 18-22—Wichita, Kan. Annual Mid-west Tractor and Thresher Show. Wichita Tractor and Thresher Club. Forum.

CONVENTIONS

Dec. 30-Jan. 1—Chicago, Ill. Twelfth Annual Meeting American Society of Agricultural Engineers. J. W. Dickinson, Secretary, Ohio State University, Columbus.

Jan. 12-14—New York. Meeting, Society Automotive Engineers.

Feb. 25-28 — New York. Sixteenth Annual Convention. American Road Builders' Assn.

War Adjustment Committee for M. A. M. A.

NEW YORK, Dec. 15—The Motor and Accessory Manufacturers Assn. has appointed a War Adjustment Committee with full power to act and to establish, if necessary, a Washington office. The committee has been formed to do such work as is necessary for M. A. M. A. members in matters relative to reconstruction policies, and particularly to cancellation of Government contracts. Members of the committee are: Chairman, Charles E. Thompson, president Steel Products Co., Cleveland; Christian Girl, president Standard Parts Co., Cleveland; Alexander W. Copland, president Detroit Gear & Machine Co., Detroit. R. M. McConnell will represent the committee in Washington.

Simplex Will Be Continued

NEW BRUNSWICK, N. J., Dec. 15—The entire assets and good will of the Simplex Automobile Co. will be placed on public sale at 10 a. m. Dec. 20 by the Wright-Martin Aircraft Corp., which owns and controls the Simplex company. The sale is merely for the purpose of simplifying accounting methods between Wright-Martin and its subsidiaries and does not mean that the Simplex company will cease to exist. Wright-Martin has every intention of continuing the company as a going concern and is understood to have plans well afoot for a post-war model.

Army Trucks for Post Office

WASHINGTON, Dec. 15.—Reports to the effect that the Post Office Department has requisitioned 10,000 parcel post trucks for use in the mail service are untrue. Although the Post Office contemplates using this many and possibly more than this number of trucks, it is making its requisitions only as the occasion warrants. The trucks will in all instances be requisitioned from the War Department and will not be purchased from manufacturers owing to the law which orders the War Department to turn over motor trucks to the Post Office for mail service as they are requisitioned.

Clutches and Controls for Detlaff

DETROIT, Dec. 15—The A. J. Detlaff Co. will hereafter confine its entire plant to the production of clutches and control sets, which have formed a large proportion of its output since its inception, in 1903. For the past year the company has been working on a 100 per cent war basis, building Type B clutches and controls, Type AA clutches and Quad control sets, and is well fitted to continue supplying these parts for the trade.

Registration Gain in Massachusetts

BOSTON, Dec. 15—Figures compiled by the Massachusetts Highway Commission for the first eleven months of this year relative to the motor registrations, etc., show that the industry in the Bay State weathered the war very well. Instead of a big falling off in the listing of vehicles there was a general gain, when a comparison is made with the same period of 1917. Here are the comparative figures:

	1917	1918	Increase
Cars	147,301	160,486	13,176
Trucks	26,964	33,011	6,074
Total vehicles	174,274	193,497	19,223
Motorcycles	11,065	12,862	1,797
Dealers, etc.	2,379	2,493	114
Licenses	69,487	67,828	*1,695
Renewals	144,742	167,312	22,570
Examinations	17,336	17,241	*95
Receipts	$1,969,813	$2,184,408	$214,595

*Decrease.

Selden Declares Dividend

ROCHESTER, N. Y., Dec. 15—At a meeting of the board of directors of the Selden Truck Sales Co., held at the general offices, a dividend of 5 per cent was declared on the first preferred stock, payable Jan. 2, 1919. At the same meeting a quarterly dividend of 2 per cent was also declared payable to stockholders of record as of Jan. 2, 1919. It is stated that shipments during the month ended Dec. 7 were greater by 28 per cent than those of any month in the past two years.

Accomplishments of the Signal Corps

Need of Purchasing Foreign Planes Early Realized—Plane Production at Rate of Nearly 3000 a Year 6 Months After Declaration of War

WASHINGTON, Dec. 13—That the Signal Corps fully realized the need for purchasing foreign combat planes until the United States was in a position to manufacture its own in sufficient quantities is one of the important points brought out in the annual report of General George O. Squier.

It was just prior to June 30, 1918, that John D. Ryan was appointed to take over this work and head the Bureau of Aircraft Production. A general policy was outlined with the opening of the war which included plans to fill vacancies in Allied flying schools with American cadets, the purchase of all the combat planes from France which could be spared, pending our own production of battleplanes, the establishment of schools and flying fields in this country, the building of training planes in this country, and the building of such types of battleplanes in this country as indicated by the needs of our Army at the front.

Within 6 months from the time war was declared, says the report, advanced training planes were being produced at the rate of 2934 per annum, and in the 7 months from December, 1917, to June, 1918, 910 battleplanes were turned out. The Curtiss JN4-D and the Standard J training planes were adopted with the OX5 and Hall-Scott A-7A engines. These planes were turned out to the number of 1204 up to June, 1918.

In explanation of the expenditures from the $640,000,000 aviation appropriations, the report states that during the 12 months ended June 30, 1918, $208,000,000 was expended exclusive of that money spent for training field construction and for operations. The expenditure exclusive of training fields and operations resulted in securing:

8,488 airplanes.
12,626 engines.
911 balloons.
115,655 instruments of various kinds.
2,717 hangars.
379 squadron equipments.
317,353 items of aviators' clothing.
33,909 items of motor transport.

For training fields and operations $165,000,000 was expended, making a total expenditure of $373,000,000 and leaving a balance of $267,000.000. It was this appropriation of $640,000,000, it will be remembered, that Congressmen and others claimed had been wastefully dissipated.

The itemized account of the expenditures and production show that Liberty engines were estimated at $4,400 per unit, Hispano-Suiza 300-hp. engines estimated at $5,000 per unit, OX5 engines $2,000 per unit and 80-hp. Le Rhone engines at $2,100 per unit.

Production of the Liberty engine started in December, 1917, with 22 engines and reached a total of 1102 for the month of June, making a total production up to June 30, 1918, of 2390. Up to the same time, 5474 OX5 engines had been produced. Twelve hundred and four training planes, 397 pursuit planes, 370 artillery planes and 143 bombing planes had been purchased abroad besides 228 various types of experimental planes.

The JN4 training plane was estimated in the Government contracts at $4,750 per unit. Also included in the tabulations are motor transport items which show that 7642 motor trucks at $2,650 each and 3898 passenger cars at $1,000 each were purchased for the Signal Corps besides numerous trailers, motorcycles and bicycles. Following is the complete report by General Squier:

Report of the Chief Signal Officer

WAR DEPARTMENT,
OFFICE OF THE CHIEF SIGNAL OFFICER,
Washington, Sept. 28, 1918.

SIR: The following report of the operations of the Signal Corps for the fiscal year 1918 is submitted:

The work to May 20, 1918, comprised the development of the Army's aviation program, supply of the Army's telephone, telegraph, radio and annunciator-buzzer systems, supply of its flag, panel and projector and other signaling requirements, its pigeon, motorcycle dispatch, meteorological and time services and the photographic work for the pictorial history of the war.

Aviation

On May 20, 1918, an executive order created the Division of Military Aeronautics and the Bureau of Aircraft Production, and relieved the Signal Corps of its aviation duties, with the exception of the design and manufacture of all radio apparatus required in the air service. In their annual reports the officers of the new division and bureau will cover their activities, as all aviation personnel, equipment and records have been transferred to them by virtue of the above executive order. Accurate records are available in the new division and bureau created which will enable a minute report of these activities to be prepared at some future time.

It is considered advisable, however, to briefly state some salient facts in this connection which, it is believed, can be safely given at this time.

One of the first steps taken by the Chief Signal Officer at the outbreak of the war was to outline some air program commensurate with the resources of the nation and the importance of the part to be played by our army in the war. It was necessary to have this in sufficient detail to form some estimate which could be presented to Congress as a basis for

Personnel Data

	1917								1918					
	April	June	July	August	September	October	November	December	January	February	March	April	May	Total
Nonflyers	.....	.....	127	71	444	530	1,124	701	856	1,454	1,145	54	1,640	8,146
Trained flyers	52	94	38	—2	74	330	327	333	663	434	2,206	1,652	1,737	7,938
Total officers	52	94	165	69	518	860	1,451	1,034	1,519	1,888	3,351	1,706	3,377	16,084
Cadets	.....	.....	.....	1,104	562	628	646	785	476	504	1,052	—70	—534	5,153
Enlisted men	1,100	10	8,997	9,491	578	1,891	14,167	51,191	4,875	17,072	19,197	4,378	9,832	142,779
Civilian employees[1]	210	414	239	473	655	746	665	852	870	972	1,349	1,473	920	9,838
Plane and engine contractors employees	.....	7,298	967	926	2,121	1,622	3,234	5,224	8,609	9,272	3,554	5,929	8,047	56,803
Examining boards[2]	.....	8	4	.....	5	3	2	20	18	—17	—5	—10	—5	23
Ground schools	.....	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	—1	7
Flying schools	2	2	1	1	2	.....	1	9	.....	.....	.....	2	5	25
Balloon schools	1	.....	.....	.....	.....	1	.....	1	.....	.....	.....	2	.....	5
Photographic schools	.....	.....	.....	.....	.....	.....	2	.....	2	.....	.....	.....	.....	4
Schools for mechanics	.....	.....	.....	.....	.....	.....	6	1	8	11	2	—13	.....	15
Hours flown	.....	.....	.....	.....	6,863	6,707	8,808	11,965	24,891	50,807	57,212	81,356	98,358	346,967
Flying deaths (United States)	.....	3	.....	4	5	2	4	8	10	26	20	18	26	126

[1]Includes about 13 per cent of Signal Corps proper. [2]Approximate.

NOTE.—Squadrons trained, equipped, and on fighting front, June, 1918, 8; July, 1918, 40; August, 1918, 52; September, 1918, 58

Statement of Condition of Current Appropriations, Including Cash Disbursements Thereunder, June 30, 1918

Appropriation and Allotment	Amount of Appropriation or Allotment	Orders and Authorities		Balance	Cash Disbursements		
		Fixed Price	Cost Plus[1]		Reported	Unreported	Total
Increase for Aviation-Signal Corps, 1918:							
Equipment division—							
201. Airplanes and spare parts	$122,700,000.00	$78,539,212.50	$128,576,174.00	$84,415,386.50	$81,441,140.89		$81,441,140.89
202. Engines and spare parts	280,770,000.00	39,410,652.25	208,142,885.00	33,216,462.75	67,687,903.80		67,687,903.80
203. Transportation	35,248,800.00	42,938,630.73		7,689,830.73	19,190,008.89		19,190,008.89
204. General equipment	11,427,800.00	34,979,741.53		23,551,941.53	22,232,938.50		22,332,938.50
205. Maintenance	22,050,000.00	17,948,955.00		4,101,044.40	4,822,886.89		4,822,886.89
206. Special clothing	1,858,440.00	2,520,512.63		662,072.63	2,154,788.34		2,154,788.34
207. Machine guns, ammunition, and bombs	37,500,000.00	29,249,033.29		8,250,966.71	29,281,207.62		29,281,207.62
208. Acquisition of plants	6,000,000.00	2,595,599.83		3,404,400.17	1,036,952.54		1,036,952.54
209. Miscellaneous	7,063,400.00	7,748,617.75		685,217.75	6,008,772.14		6,008,772.14
Total	524,618,440.00	255,930,956.11	336,719,059.00	68,031,575.11	233,956,599.61		233,956,599.61
Construction division—							
221. Purchase of land	950,000.00	695,429.19		254,570.81	583,065.27		583,065.27
222. Lease of land							
223. Construction of buildings, United States	30,506,400.00	50,863,057.71		20,357,257.71	41,317,796.75		41,317,796.75
224. Construction of buildings abroad	10,000,000.00	10,673,577.65		673,577.65	19,020,095.09		19,020,095.09
Total	41,456,400.00	62,232,664.55		20,776,264.55	60,920,957.11		60,920,957.11
Balloon division—							
241. Balloons	11,800,000.00	9,780,156.85		2,019,843.15	1,863,302.39		1,863,302.39
242. Accessories	1,000,000.00	477,853.25		522,146.75	277,177.79		277,177.79
243. Balloon buildings	995,000.00	98,884.16		896,115.84	1,387,973.77		1,387,973.77
244. Transportation	5,000,000.00	1,243,749.26		3,756,250.74	694,148.33		694,148.33
245. Gas	5,000,000.00	3,479,402.50		1,520,597.50	6,499,864.22		6,499,864.22
246. Miscellaneous	3,324,550.00	1,830,845.18		1,493,704.82	695,755.77		695,755.77
Total	27,119,550.00	16,910,891.20		10,208,658.80	11,418,222.27		11,418,222.27
Schools division—							
261. Aeronautical schools, maintenance	1,056,000.00	1,016,223.48		39,776.52	1,190,367.42		1,190,367.42
Finance division—							
281. Expenses on special duty at home and abroad	67,200.00	50,140.00		17,060.00	50,140.00		50,140.00
282. Pay of Reserve Corps and traveling expenses	31,627,862.00	14,074,995.85		17,552,866.15	3,053,039.73		3,053,039.73
283. Pay of civilian employees	5,720,000.00	3,849,807.67		1,870,192.23	3,879,636.82		3,879,636.82
284. Vocational training	120,000.00	238,085.73		118,085.73	161,500.12		161,500.12
285. Subsistence and travel of students	756,000.00	0.00		756,000.00	0.00		0.00
286. Experimental investigations	1,458,548.00	2,710,198.40		1,251,650.40	1,614,473.02		1,614,473.02
287. Miscellaneous expenses	900,000.00	137,543.16		762,456.84	158,895.78		158,895.78
288. Departments and depots	1,000,000.00	165,595.14		834,404.86	262,667.74		262,667.74
289. Reserve for foreign expenditures	4,000,000.00	17,400,000.00		13,400,000.00	17,400,000.00		17,400,000.00
290. Expenses for the Aircraft Board	100,000.00	47,250.00		52,750.00	58,169.59		58,169.59
Total	45,749,610.00	38,673,615.95		7,075,994.05	26,638,522.80		26,638,522.80
Total, increase for Aviation-Signal Corps, 1918	640,000,000.00	374,764,351.29	336,719,059.00	71,483,410.29	334,124,669.21	3,726,605.71	337,851,274.92
Sales section—Obligations[2]		157,969,653.42	18,955,250.00	176,924,903.42	25,966,739.95		25,966,739.95
Total disbursements, increase for Aviation-Signal Corps, 1918[4]					360,091,409.16	3,726,605.71	363,818,014.87
Other aeronautical appropriations and allotments:							
Aviation, seacoast defenses	2,839,010.98	21,407.12		2,817,603.86	24,511.14		24,511.14
Aviation, seacoast defenses, insular possessions, Hawaii	438,677.97	84,445.00		354,232.97			
Aviation, seacoast defenses, insular possessions, Philippines	578,110.36	2,078.66		576,031.70	52,509.70		52,509.70
Aviation, seacoast defenses, Panama Canal	500,000.00	482,000.00		18,000.00	485,739.00		485,739.00
Aviation, Navy, 1917-18, Navy transfer under act Mar. 4, 1915[5]	350,000.00	350,000.00		0.00	333,000.00		333,000.00
Signal service of the Army (no year)	4,500,000.00	4,333,484.59		166,515.41	4,375,000.00		4,375,000.00
Signal service of the Army 1917-18, aeronautics act June 15, 1917[3]	31,846,067.16	31,846,067.16		0.00	[4]41,024,350.40		[4]41,024,350.46
Signal Service of the Army 1918, aeronautics act May 12, 1917[3]	10,800,000.00	8,421,162.79		2,378,837.21	[4]20,121,191.82		[4]20,121,191.82
Total, other aeronautical appropriations and allotments	51,851,866.47	45,540,645.32		6,311,221.15	66,416,302.12		66,416,302.12
Total, all aeronautical appropriations and allotments	691,851,866.47	578,274,650.03	355,674,309.00	242,097,092.56	426,507,711.28	3,726,605.71	430,234,316.99
Signal service appropriations and allotments:							
Signal Service of the Army 1917-18, Signal Service act June 15, 1917[6]	15,421,698.84	15,421,698.84		0.00	(9)		(9)
Signal Service of the Army, 1918[3]—							
Signal Service act May 12, 1917 $1,000,000							
Signal Service act Oct. 6, 1917 40,000,000							
	41,000,000.00	43,378,837.21		2,378,837.21	(9)		(9)
Maintenance, etc., fire control installations at seacoast defenses	141,339.43	78,876.30		62,463.13	129,667.10		129,667.10
Maintenance, etc., fire control installations at seacoast defenses, insular possessions	12,506.58	12,041.53		465.05	10,780.46		10,780.46
Maintenance, etc., fire control installations at seacoast defenses, Panama Canal	10,650.68	9,334.12		1,316.56	10,525.68		10,525.68
Washington-Alaska Military Cable and Telegraph Systems, 1918-19	50,000.00	49,904.22		95.78	49,905.00		49,905.00
Signal equipment Enlisted Reserve Corps, 1918	300,000.00	300,000.00		0.00	298,500.00		298,500.00

[1]Cost plus obligations are included under fixed price column, except for airplanes and engines.

Statement of Condition of Current Appropriations, Including Cash Disbursements Thereunder, June 30, 1918—Continued

Appropriation and Allotment	Amount of Appropriation or Allotment	Orders and Authorities		Balance	Cash Disbursements		
		Fixed Price	Cost Plus[1]		Reported	Unreported	Total
Commercial Telephone service at Coast Artillery Posts, 1918—							
Act May 12, 1917	$8,500						
Act Oct. 6, 1917	5,000						
	13,500.00	13,500.00		0.00	13,416.00		13,416.00
Fire control in insular possessions	12,834.38	4,251.59		8,582.79	10,196.68		10,196.68
Fire control at fortifications	16,025.90	8,826.94		7,198.96	7,338.80		7,348.80
Fire control at fortifications, act June 15, 1917	446,761.96	213,611.73		233,150.23	349,550.00		349,550.00
Contingent expenses seacoast fortifications	51,038.68	46,573.30		4,465.38	49,000.00		49,000.00
Board of Ordnance and Fortifications	15,088.43	689.13		14,399.30	13,254.09		13,254.09
Supplies, services and transportation, etc., 1918	16,882.73	15,000.00		1,882.73	15,000.00		15,000.00
Supplies, services and tranportation, 1917-18	100,000.00	100,000.00		0.00	100,000.00		100,000.00
Ordnance and Ordnance Stores, Bureau of Ordnance, 1917-18	9,600.68	1,086.00		8,514.68	1,086.00		1,086.00
Total, Signal Service appropriations and allotments	57,617,928.29	59,654,230.91		2,036,302.62	1,058,235.81		1,058,235.81
Replacing Signal Corps supplies and equipment, 1917-18	136,918.43	136,281.34		637.09	133,600.00		133,600.00
Replacing Signal Corps supplies and equipment, 1918-19	361,954.21	124,944.23		237,009.98	125,000.00		125,000.00
Total, replacing appropriations	498,872.64	261,225.57		237,647.07	258,600.00		258,600.00
Grand total	749.968,667.40	638,190,106.51	355,674,309.00	243,895,748.11	427,824,547.09	3,726,605.71	431,551,152.80

[1]Cost plus obligations are included under fixed price column, except for airplanes and engines.
[2]Unreported cash disbursements consist of cash in the hands of disbursing officers U. S. A.
[3]Sales section, obligations include orders and authorities for materials, etc., purchased by the "Signal Corps" (old) for resale. A portion of this amount.
[4]Cash disbursements against sales section, obligations are included under the total withdrawals of I. A. S. C. appropriation.
[5]This is an allotment given the "Signal Corps" by the "Navy Department."
[6]The total of these two items comprises one appropriation "Signal Service of the Army 1917-18, act June 15, 1917."
[7]Includes withdrawals from Treasury for Signal Service part of the appropriation.
[8]The total of these two items comprises one appropriation "Signal Service of the Army 1918."
[9]Withdrawals from Treasury for Signal Service part of the appropriation included in withdrawals under aeronautical appropriations.
NOTE.—For the fiscal year 1918, the appropriations for both the Signal Corps and Aviation were disbursed from one office in the Bureau of Aircraft Production as a plan agreed to by the Chief Signal Officer of the Army, the Director of Aircraft Production and the Director of Military Aeronautics, which was approved by the Secretary of War. The financial statement therefore covers all of these activities.

appropriations of funds to begin this work. A program was formulated and certain general estimates prepared to inaugurate the work, and in due course Congress appropriated the sum of $640,000,000 for the purpose. This money became available July 24, 1917.

Due to long years of practical neglect of aeronautics since the Wright Bros. brought out the original flying machine, the outbreak of war found the United States with but a handful of flyers and very few training machines. There was practically no aviation industry in this country, and the number of professional men trained as aeronautical engineers and designers was so small as to be practically negligible. In this respect the problem of developing the air program was unique. The United States had built ships before, had manufactured clothing, built cantonments, guns, ammunitions, etc., and had a splendid body of men trained in these professions; but, outside of a few men, there was no one in the United States with experience in the design or building of even training planes.

How, then, was this problem to be met? Within a few days after the outbreak of war, without proceeding through the regular diplomatic channels, an appeal was made to the military attachés of France, England and Italy to send to this country forthwith the most experienced and trained flyers, aeronautical engineers and designers who could be spared to assist us in this work. As a result, within a very short time, there arrived a number of foreign officers from these countries, who reported for duty officially to the Chief of Staff, and were immediately placed on the working staff of the Chief Signal Officer, directly in his office. Special authority was obtained from Congress to pay the mileage of these officers sent here for duty, and they were utilized in every possible way from the beginning in developing both a system of schools and the matériel required. Simultaneously a strong technical commission was sent to Europe. This policy has been continued to the present day without interruption, and new officers with the latest experience are continually arriving to replace the officers who have finished their tour of duty here. At the same time special designers from England, France and Italy were brought to this country to design machines for the United States; some of them already have produced very promising results. Coincident with this the small group of aeronautical engineers which this country had available were set to work individually on a different type of machine, and some of these machines already have been approved for production.

Within a very few days after the outbreak of war an arrangement was made between the War Department and Canada by which the United States was to receive the designs worked out for flying fields; and in order to hasten the training of our aviators during the construction of our training schools, American cadets were sent to Canada, France and Italy to be trained in their flying schools. In addition to this an arrangement was made by which 10 flying squadrons of the air service were to be trained by the British Government and also equipped with machines and transport complete and ready for service at the front, in exchange for providing flying facilities for the Royal Flying Corps of Canada during the winter months. This resulted in the movement of the Royal Flying Corps establishment to the new fields constructed at Forth Worth, Tex. This exchange also resulted in a tremendous stimulus being given to our own flying schools, which in the meantime had been completed, as it furnished a standard of training in our midst which served as a pacemaker to our own cadets.

For the period of 14 months from the outbreak of the war to the end of May, when the aviation section of the Signal Corps was turned over to the new Division of Military Aeronautics and the Bureau of Aircraft Production, the following table shows briefly the increase effected:

	April 1, 1917	May 31, 1918	Increase (per Cent)
Officers	52	16,084	30,930
Enlisted men	1,100	147,932	13,440
Civilian employees	210	9,838	4,680

It will be seen from the above that the Signal Corps turned over to the Division of Military Aeronautics and the Bureau of Aircraft Production, 16,084 officers and 147,932 enlisted men, and that the increase from April 1, 1917, to the time of this transfer was 31,000 per cent for officers and 13,000 per cent for enlisted men. Of these, there were 7938 officer flyers who successfully graduated from the ground and flying schools, an increase for the period of 15,246 per cent in the commissioned flying personnel. The statement on Personnel Data gives the details of these increases. There were 167 deaths due to flying accidents of the year in the United States, or one to every 147,840 miles of recorded flight, a lower ratio of deaths than that of our allies.

In reporting upon the accomplishments of the year it must not be overlooked that the greatest thing done, in a fundamental way, was the creation of an industry capable of supplying the needs of the future for aircraft and aircraft accessories, there being now engaged in this work about 350 concerns, employing an industrial army of 200,000 men and women. This accomplishment is all the greater when it is realized that everything pertaining to aircraft equipment is of a highly technical nature, extremely difficult to produce.

Matériel.—When the United States entered the war, it was evident that the time was fast approaching when the reservoirs of raw material for the allies were to be found only in the United States and that America's effort should be so organized from the beginning as to furnish a continuous flow of this necessary raw material, not only for our own program but for those of our allies as well. In other words it was clear that the spruce, the fabric, the dope and the oil must be produced as a part of our program on a scale to supply also the air programs of our allies.

Manifestly, therefore, each step made in the beginning must be made with a view to our allies as well, and no policy must be restricted to the United States alone. Just as our land units were later assigned to English and French units so must our materials be freely pooled and assigned to our allies as well as ourselves. The closest co-operation was established, therefore, with our allies in determining the scope of America's efforts. In addition, the needs of our own navy and the navy of Great Britain also were included in the army's program for furnishing these essentials.

One of the serious mistakes which the allies had fallen into at the time the United States entered the war was the development of a multiplicity of types of engines and planes which made it impossible to have a large number of any one of these types. As a further consequence, the trained personnel on the ground to operate and repair the machines had grown to such a proportion that it was estimated from 30 to 50 men were required on the ground to keep each one of the many types of planes in the air on the fighting line. Manifestly, unless this large number of trained men per fighting plane could be reduced by some means it would be hopeless to expect within a reasonable time to put into the air thousands of flying planes, because a single thousand planes on this basis would require from 30,000 to 50,000 men in attendance.

Common sense, therefore, dictated the following general policy, which was followed:

(*a*) To fill up all vacancies in allied flying schools with the maximum number which could be accommodated, to gain time in training our flyers while our schools were being built. This was done to the limit which could be accepted by each of the allied governments in Canada, Italy, England and France.

(*b*) To purchase from France all the combat planes which the French could possibly spare from their own needs, for delivery at the earliest moment, to supply our forces overseas, pending the time our own production of battle planes could be developed. This was done, and, furthermore, raw materials and even mechanics to help make these planes were furnished by the United States, and at the present time satisfactory deliveries are being made on these contracts entered into early in the war.

(*c*) To establish schools and build flying fields for training aviators in this country.

(*d*) To provide training planes to train aviators in this country.

(*e*) To build such types of battle planes in this country as the needs of our army at the front should indicate, and supply such additional aviation equipment as was required for overseas use.

The accomplishment following these policies is best shown by referring to the statements, Aviation Equipment Production and Personnel Data, which form a part of this report. The former shows month by month the actual deliveries of aviation equipment from July 1, 1917, to June 30, 1918, and the latter the monthly personnel increases for the same period.

The following comments refer to the data contained in the statement, Equipment Production:

Primary Training Planes.—Obviously, the first task was to provide an adequate number of training planes for our cadets. The Curtiss JN4-D and the Standard J types were selected and passed upon by the Joint Army and Navy Technical Board as the two available planes then in this country. In the quantity production of completed planes the limiting factor is the production of engines. The OX5 engine and Hall-Scott A-7A were the only two available engines, and the Standard J, while not the equal of the JN4-D plane, was approved by the said Joint Army and Navy Board because it would accommodate the Hall-Scott A-7A engine until such time as the production of the Curtiss OX5 engines could be increased. The production of primary training planes was within six months fully adequate to the needs of the service.

Advanced Training Planes.—After the production of primary training planes was secured, and it was necessary to develop planes for advanced training, and within six months these planes were being produced at the rate of 3924 per annum.

Battle Planes and Engines.—In the development of battle planes the first problem to be solved was that of the engine. Common sense required that the most approved types of European engines which could be made in this country should be ordered. This was done, the first large contract for Hispaño-Suiza engines being given July 30, 1917, while the first contract for Liberty engines was not let until Sept. 4 of that year. By the end of May, 1918, more than 2000 of these foreign motors had been produced by American factories. It was early apparent, however, that the tendency was toward greater horsepower than was being developed by any approved foreign engine. Consequently, coincident with the production of such approved types of foreign engines as were available for production in this country, a new engine, later known as the Liberty engine, was developed and placed in production. While the production of this engine at the end of May, 1918, was not as great as the production of the approved types of foreign engines which had been earlier arranged for, nevertheless, the wisdom of this course is becoming daily more apparent, since the foreign types produced here, although used by our allies on the Western Front, are not thought to be of sufficient horsepower to put in planes for overseas shipment, and the Liberty engine has become the main reliance of our battle program. It has proved satisfactory not only to our own Army and Navy, but to the air services of our allies as well. It is not an invention, but stands as the accomplishment of American adaptability and foresight. The development of the Liberty motor was required by the logic of the situation, which the event has proved to have been correctly estimated. The production of battle planes had necessarily to follow the production of engines. The best aeronautical talent available in this country was employed to that end. The assistance of Mr. Orville Wright, at Dayton, Ohio, has been of great value, but necessarily the accomplishment in this field must be due to the hearty and loyal co-operation of the representatives of the allies. This we received in the fullest measure and their able and generous assistance was utilized to the utmost.

Overseas Plane Production.—Out of the appropriation available our allies produced in their factories the following planes for American units:

	Training	Battle
1917		
December	394	5
1918		
January	196	4
February	233	90
March	130	98
April	122	99
May	11	299
June	118	315
Total	1,204	910

Balloons.—The supply and equipment of the balloon organizations have been adequate to the service.

Machine Guns.—While this office was responsible for obtaining the armament, ammunition and bombs required out of the available appropriation, the same was done through the Chief of Ordnance. These articles are being delivered in sufficient quantities.

Raw Materials.—Due to the fact that there was at the beginning of the war practically no airplane industry in this country, there was an inadequate supply of nearly all raw materials necessary in their construction. A broad foundation had to be laid in this regard to meet not only our own requirements, but those of the allies, who were coming to depend more and more upon this country. The production of spruce had to be tremendously increased, necessitating the building of mills, railroads and other equipment. As it was impossible to produce the millions of yards of linen fabric required a suitable cotton substitute was developed which is now being manufactured in this country in quantities sufficient to meet the needs of both America and her allies. This accomplishment, heretofore thought to be impossible, ranks among achievements of the first importance. The dope which is used on the fabric of airplanes presented many difficulties not only to us but to our allies. This and other

Appendix A.—Aviation Equipment Production (Actual Deliveries)

	Estimated Average Price per Unit	1917							1918						Total for Year
		June	July	August	September	October	November	December	January	February	March	April	May	June	
Number of cost plus plane and engine contractors employees		7,298	8,265	9191	11,312	12,934	16,168	21,392	30,001	39,273	42,827	48,756	56,803	64,297	
Number of plane contractors			6	5	5	4	7	13	10	8	10	12	13	13	
Number of engine contractors					4	4	6	8	8	7	8	8	10	12	
Planes:															
JN-4-D	$4,646.00	147	56	87	171	279	293	313	485	153	311	320	380	112	2,960
JN-4-H, training	4,750.00								7	179	153	61		2	402
JN-4-H, gunnery	4,750.00											9	81	222	312
JN-4-H, bombing	4,750.00												49	51	100
SJ-1	4,500.00			16	22	61	38	110	215	373	445	313	7		1,600
S-4-B	5,250.00						1	20	22	20	25	11	1		100
S-4-C (S-5)	5,000.00												35	38	73
Penguin	2,025.00											12	32	14	58
Bristol fighter	6,750.00										2		13	9	24
De-H-4	6,512.00										13	15	153	336	517
Training, purchased abroad								394	196	233	130	122	11	118	1,204
Pursuit, purchased abroad								2	2	2	45	21	240	85	397
Artillery, purchased abroad										26	21	55	59	209	370
Bombing, purchased abroad								3	2	62	32	23		21	143
Experimental planes, various types			20	28	34	11	27	34	13	31	12	8	10		228
Engines:															
OX-5	2,000 00	160			269	154	377	216	198	429	835	1,003	1,148	845	5,474
A-7-A	2,182.00				82	117	166	202	319	353	355	320	139	130	2,183
Gnome 100	2,314.00				43	5	3	9	15	2	41	1	86	6	161
Le Rhone 80	2,100.00												14	54	68
Hispano 150	3,600.00						93	147	85	170	306	444	530	413	2,188
Hispano 180	3,600.00													6	6
Hispano 300	5,000.00												2		2
Lawrence	500.00										7	29	30	48	114
Liberty 12	4,400.00							22	39	70	122	415	620	1,102	2,390
Fiat, purchased abroad													40		40
Balloons:															
Balloons	6,141.00	8	2	3	2	5	22	37	51	36	46	50	72	85	411
Balloon cloth, M yards	650.00									58	69	154	248	371	900
Ferro silicon, tons	261.00					20		224	120	56	270	140	74	20	924
Caustic soda, tons	78.40				16	93	25	106		200	100	124		76	740
Hydrogen cylinders	21.80	800	500	1500	500	500	12,000	18,000	1,500	100	2,000	10,100	15,900	6,900	69,500
Cable, M feet	120.00				120		60	300	6	120		317	136	72	1,131
Winches	7,000.00											15	5	4	24
Propellers:															
Propellers, training	84.81		30	30	30	87	675	1,038	982	1,223	3,037	4,567	3,918	4,467	20,084
Propellers, combat	136.40										43	53	408	435	939
Propellers, experimental			24	10	18	20	72	56	30	56	81	57	58	15	497
Lumber:															
Mahogany, M feet											2,985	1,591	951	1,612	7,139
Walnut, M feet											840	644	386	214	2,084
Spruce, M feet				184	3,159	3,953	4,660	3,183	3,503	10,663	10,441	10,671	8,354	5,958	64,729
Fir, M feet						65	1,656	1,497	1,982	6,112	3,484	4,493	4,683	3,035	27,007
Oak, M feet											286	21			307
Birch, M feet											631		8		639
Guns, ammunition, and bombs:															
Machine guns, Lewis	601.70						4	3	66	1,376	1,707	1,450	1,922	3,840	10,368
Machine guns, Marlin	370.67						7	5	2,122	3,123	3,078	7,845	4,565	1,609	22,354
C. C. gears	85.00					5	1		30	50	84	463	851	784	2,268
Mechanical gears	42.25									3	22	35	65	130	255
Gun mounts	135.00						41	241	1,017	991	1,617	1,647	1,813	1,089	8,456
Ring and post sights	18.00								470	730	47	2,525	2,074	1,204	7,050
Wind vane sights	16.00								22	116	746	2,671	2,074	1,204	6,833
Gun stems	3.70							113	492	629	1,069	1,126	800	424	4,653
Ball A-1, M rounds	46.10												3,240	2,160	5,400
Armor piercing, M rounds	68.72											703	751	451	1,905
Incendiary, M rounds	105.00											185	601	900	1,686
Tracer, M rounds	105.00											225	751	1,899	2,875
Barlow heavy	100.00										2	42	1,441	343	1,828
Dummy drop, Mark I	1.80									96	881	2,013	3,060	5,352	11,402
High capacity, Mark I	20.50												2,823	9,901	12,724
High capacity, Mark II	19.25											62	103	524	689
High capacity, Mark III	16.25											3,000	11,361	11,804	26,165
Incendiary, Mark I	15.25												27	550	577
Incendiary, Mark II	14.25												2	2625	2,627
Bomb sights, Mark I-A	67.30										4	7	33	130	440	614
Releases, Barlow, heavy	56.00									1	1	1	15	1	708	727
Instruments:															
Air pressure gauge	1.85	40							402	499	1,430	1,848	700	1,379	6,258
Air speed indicator	35.00	8						54	35	272	305	695	482	271	2,114
Altimeter	60.00						400	919	732	1,773	1,740	1,4 0	2,529	425	9,998
Safety belts, standard	5.00								51	696	1,116	1,306	553	565	4,287
Clocks	13.10	25						80	503	1,836	1,954	2,597	2,105	1,225	10,300
Compass	25.00	90									64	1,126	1,384	1,929	4,503
Fire extinguisher	5.00	220					100	220	376	568	2,751	50	3,287	826	8,178
Oil pressure gage	1.50	3							414	661	915	2,102	1,624	2,088	7,804
Thermometer	8.00	51						102	643	652	1,675	1,533	2,396	934	7,935
Safety belts, gunners'	10.00												45	261	306
Tachometer	35.00	41						26	210	646	2,332	4,053	3,263	2,516	13,046
Rotating map cases													4		4
Pilots' and observers' switch panels	11.75											23	352	615	990
Negative lenses	13.25	5											50	2,291	2,341
Unit sights	55.00								44	77	186	235	188	994	1,724
Tachometer shaft assemblies	5.00							29	365	1,387	5,628	1,403	1,220	1,586	11,618
Dreyer oxygen apparatus	160.00	2									2	96	466	501	1,065
Oxygen tanks, No. 12	5.15										6	1	2,970	7,023	10,000
Gasoline gages	10.00						150	5			17	158	1	48	379
Radio receiving sets										850	285	651	2,480	1,482	5,748
Radio transmitting sets										224	194	698	634	369	2,119
Radio combination sets												42	787	47	876
Radio interphone units												1,634	966		2,600
Cameras, aero	406.87					10	93	10	67		119	64	140	144	647
Cameras, enlarging	125.00						7	2	23	110	115	150	56		463
Cameras, gun	150.00						2	20	30	50	100	80	50	20	352
Hangars:															
Balloons	5,493.33			1		2					4			2	9
Canvas											450	620	712	358	2,140
Metal												64	184	320	568

Appendix A.—Aviation Equipment Production (Actual Deliveries)—Continued

	Estimated Average Price per Unit	1917							1918						Total for Year
		June	July	August	September	October	November	December	January	February	March	April	May	June	
Dope:															
Acetate	$4.75								2,034	191,405	25,300	71,550	35,225	139,017	464,531
Nitrate, gallons	1.80								.....	500	.....	1,550	7,190	16,950	26,190
Plane fabric:															
Linen, yards	1.00								.....	.....	312,125	628,793	620,530	179,187	1,740,635
Cotton, yards	.60							10,716	119,777	251,674	319,445	402,371	718,272	1,342,491	3,164,746
Plane tape, M yards	40.00								.....	700	750	2,504	1,341	366	5,661
Castor beans planted, acreage									.....	.....	12,800	49,400	87,300	89,550	239,050
Castor oil, gallons							108,500	187,935	210,000	.....	.....	.....	.....	.....	506,435
Squadron equipment:															
Service	64,091.78								81	150	.....	.....	.....	.....	231
Supply	71,392.07								24	9	.....	.....	4	.....	37
Repair	65,000.00								6	4	.....	.....	4	.....	14
Construction	232,619.51								44	53	.....	.....	.....	.....	97
Clothing:															
Boots, pairs	4.62	9	.....	.....	.....	288	212	.....	4	4,500	4	840	2,200	2,550	10,598
Coats	15.40	84	.....	60	141	1,405	3,964	813	6,750	6,147	7,612	11,582	3,100	3,607	45,181
Gauntlets		11	.....	.....	.....	11,604	9,508	17,044	5,320	4,721	1,811	16	.....	.....	50,024
Gloves	15.15	2	.....	.....	400	.....	300	126	.....	916	792	.....	.....	.....	2,534
Goggles	4.50	5	.....	.....	.....	12	750	691	1,242	6,007	14,320	9,111	5,907	4,079	42,119
Guards	6.95	4	.....	.....	.....	270	1,730	124	.....	.....	.....	.....	.....	.....	2,124
Helmets	4.20	35	.....	.....	400	1,680	3,260	4,034	3,162	11,111	7,871	12,026	10,103	6,500	60,147
Masks	1.12	1	.....	.....	200	.....	.....	.....	4	1	3,005	1,152	20	1,120	5,502
Moccasins, pairs	7.70	.....	.....	.....	.....	.....	.....	2,022	604	1,067	2,914	2,508	1,522	4,000	14,637
Scarfs	1.09	1	.....	.....	.....	.....	.....	.....	.....	.....	3	3,153	1,500	1,500	6,156
Sweaters	5.06	.....	.....	.....	200	600	2,760	1,740	.....	600	1,467	1,352	4,100	2,600	15,419
Suits	19.50	.....	.....	.....	385	265	225	.....	2,749	589	3,742	11,842	10,593	6,480	36,870
Trousers	2.75	.....	.....	.....	.....	1,270	4,099	37	6,750	2,218	2,668	4,945	1,655	2,400	26,042
Motor transport:															
Motor trucks	2,650.00	28	47	249	111	980	539	1,136	854	864	838	702	658	664	7,642
Motor-truck, bodies	220.00	.....	.....	1	.....	.....	.....	235	50	144	293	246	443	1,336	2,748
Trailers	575.00	.....	.....	72	.....	28	116	28	8	20	208	484	808	1,418	3,190
Motor cars	1,000.00	4	8	27	50	406	529	542	587	455	413	326	125	430	3,898
Motorcycles	300.00	38	132	21	321	127	1,259	792	743	581	533	759	1,207	814	7,289
Motorcycle side cars	75.00	38	97	21	281	106	1,076	1,050	757	489	664	1,250	1,140	699	7,630
Bicycles	35.00	.....	.....	.....	.....	204	804	315	189	.....	.....	.....	.....	.....	1,512
Percentage forgings, finished, semi-finished, and raw materials, costing about $9,000,000, weighing over 23,000 tons, actually freighted on steamers to allies account American plane production	.....	.....	.....	.....	.....	14	15	17	12	9	17	3	4	5	96
Dollars actually spent during the month, in thousands (from accounts current)	.....	$1,127	$7,880	$255	$6,065	$13,626	$23,467	$39,151	$35,193	$28,797	$34,384	$39,209	$45,267	$45,266	$321,784

chemicals required are now being produced in this country in sufficient quantities for their requirements as well as our own. There was a great deficiency in the production of castor oil. This necessitated the planting of over 108,000 acres of castor bean plants as well as the establishment of the necessary crushing plants and refineries. It is thought that this problem has been solved.

Instruments.—It will be noted in the statement, Aviation Production Equipment, that there were about 20 types of instruments developed and in production to June 30, 1918, as necessary to give airplanes, pilots and observers the greatest possible usefulness. It may be said that the making of these instruments is a new industry for America. Their production must keep abreast of the battle-plane production, as such planes without them are useless for battle purposes.

Expenditures.—During the 12 months ended June 30, 1918, there was expended a total of about $373,000,000. From this should be deducted approximately $165,000,000 spent for completing training fields and for training and operation purposes in this country and abroad. This leaves a balance of about $208,000,000 expended in obtaining these items:

Airplanes	8,488
Engines	12,626
Balloons	411
Instruments of various kinds	115,655
Hangars	2,717
Squadron equipments	379
Items of aviators' clothing	317,353
Items of motor transport	33,909

In addition to this it should be remembered that the expenditure of this sum does not bear a direct relation to the cost of the articles produced, for the reason that much of it is locked up in inventories of uncompleted articles and in facilities for production which will ultimately reduce the cost of additional articles. Out of the appropriation of $640,000,000 there was then a balance of approximately $267,000,000 unexpended, which should in time produce the estimates of material upon which the original program was based.

Summary.—It is unnecessary to repeat the story of the Liberty engine, although many of the details are yet to be told. The whole conception of a standardized American engine, utilizing the special American genius for quantity production, for service not only in the program of the United States but for universal service for all of the allies, was a national undertaking which, for daring and farsightedness, it is believed, will be an increasing cause of pride for the American people. On Oct. 12, 1918, the completion of the 10,000th Liberty engine was celebrated in Detroit. There is no possible yardstick to measure the present and potential value of the Liberty engine. It cannot be measured by any money standard. One has only to consider what would be the result at this moment of subtracting from the allied air programs the Liberty engines as a whole to obtain some idea of this accomplishment.

The American-made DeHaviland battleplane, modified to receive the Liberty engine, is at the moment recognized as one of the best battleplanes anywhere on the Western Front, and the delivery of these planes in France has already overtaken for the moment the creation of the necessary facilities and personnel for their use.

The development of a fabric which can be furnished by America in required quantities and at price slightly over half that of the formerly used linen fabric, of which there was a limited supply, is another achievement of American ingenuity and enterprise.

The creation of special radio apparatus, the details of which cannot be mentioned here, permitting new control of the operations of airplanes en masse, is another contribution to the credit of American engineers and American manufacturers.

In short, it was always the general allied cause which controlled the decisions in founding this industry, rather than the needs of the United States alone, and this is obviously the only correct point of view. After four years of war, in which the United States entered but a year and a half ago, the allies are depending largely upon America, to a greater and greater degree as the days pass, for the castor oil for their engines, the fabric to cover the planes and the dope with which to treat the fabric, the spruce and fir to make their planes, and the engines to propel them.

GEORGE O. SQUIER,
THE SECRETARY OF WAR. *Major General, Chief Signal Officer.*

Funds available:

Act May 12, 1917	$10,800,000.00
Act June 15, 1917	31,846,067.16
Act July 24, 1917	640,000,000.00
	682,646,067.16
Disbursements to June 30, 1918	373,318,388.64
To balance	309,327,678.52